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Team: Overdrive

Detailed Design Specification

Project: Auto Performance Analyzer

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Last Updated: Friday, October 04, 2013 11:40:58 PM

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Document Revision History

Revision Number	Revision Date	Description	Rationale
01.0	9/22/2013	Rough Draft	
02.0	10/04/2013	Baseline	review corrections and updates

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1. Introduction

1.1 Product Overview

The Auto Performance Analyzer shall consist of one mobile application, running on a smartphone or tablet, for a pre-existing COTS (Commercial Off The Shelf) device that will plug into any car's (model 1996 or newer) On Board Diagnostics – generation II connector (OBD-II). The pre-existing module shall connect and communicate with the mobile application, only returning data that was requested, via Bluetooth. The COTS device is commercially designed to be small and can handle temperature extremes of -20°C to +75°C.

The mobile application shall query the on-board computer through the COTS device, which will obtain the data from the car and will provide such data to the mobile application. This application will give the user the option to choose the parameters of interest from a list and will display the data in real time.

The mobile application shall provide the user with the option to retrieve and clear trouble codes that are produced by the car when the check-engine light is on. The mobile application will retrieve the trouble codes data from the car and pull the information from a trouble code database stored in the device when the application is installed. The trouble code retrieval, interpretation and clear feature will be displayed in a separate screen independent of the parameter's display screen.

1.2 Purpose and Use

The purpose of this document, Detailed Design Specification or DDS, is to extend the Architecture Design Specification Document (ADS) and presented in detail how the Auto Performance Analyzer will be implemented. The DDS takes the layers and subsystems from the ADS and breaks them down even more into individual modules inside the subsystems. Included is a graphical display of the systems architecture along with a layer by layer detailed description. Each of these modules will handle specific tasks and will describe how modules handle those tasks and interface with other modules. The DDS will also describe internal data, dependencies, and Pseudo Code that goes along with these modules. The DDS document provides the Auto Performance Analyzers operating system dependencies with the Android operating system along with the many testing considerations that must be implemented. The DDS will lead to software implementation.

1.3 Project Scope

The scope of the Auto Performance Analyzer project is to create a diagnostics module that interfaces with the OBD-II connector system in automobiles to retrieve information from that automobile. The Auto Performance Analyzer will provide a mobile user interface with enhanced tools for data logging, vehicle diagnosis, and real time statistics. The interface will be available for Android devices, such as smart phones and tablets. The application will be able to display the cars' parameters data as digital numeric readouts and graphs to the user.

In order to populate the user interface with data, the module retrieves this data from the existing OBD-II connector, parses and reformats it. The module will then transmit it over the Bluetooth connection, to the mobile device, in real time.

2. Architecture Overview

2.1 Architectural Vision

The Auto Performance Analyzer was created in a way that would allow the system to be structurally independent. The goal was to make the software have low coupling and high cohesion. The system was separated into five layers: the GUI layer, the Event Management layer, the Database Management layer, the Processing layer, and the Bluetooth layer. The layer structure is shown in figure 2.1.

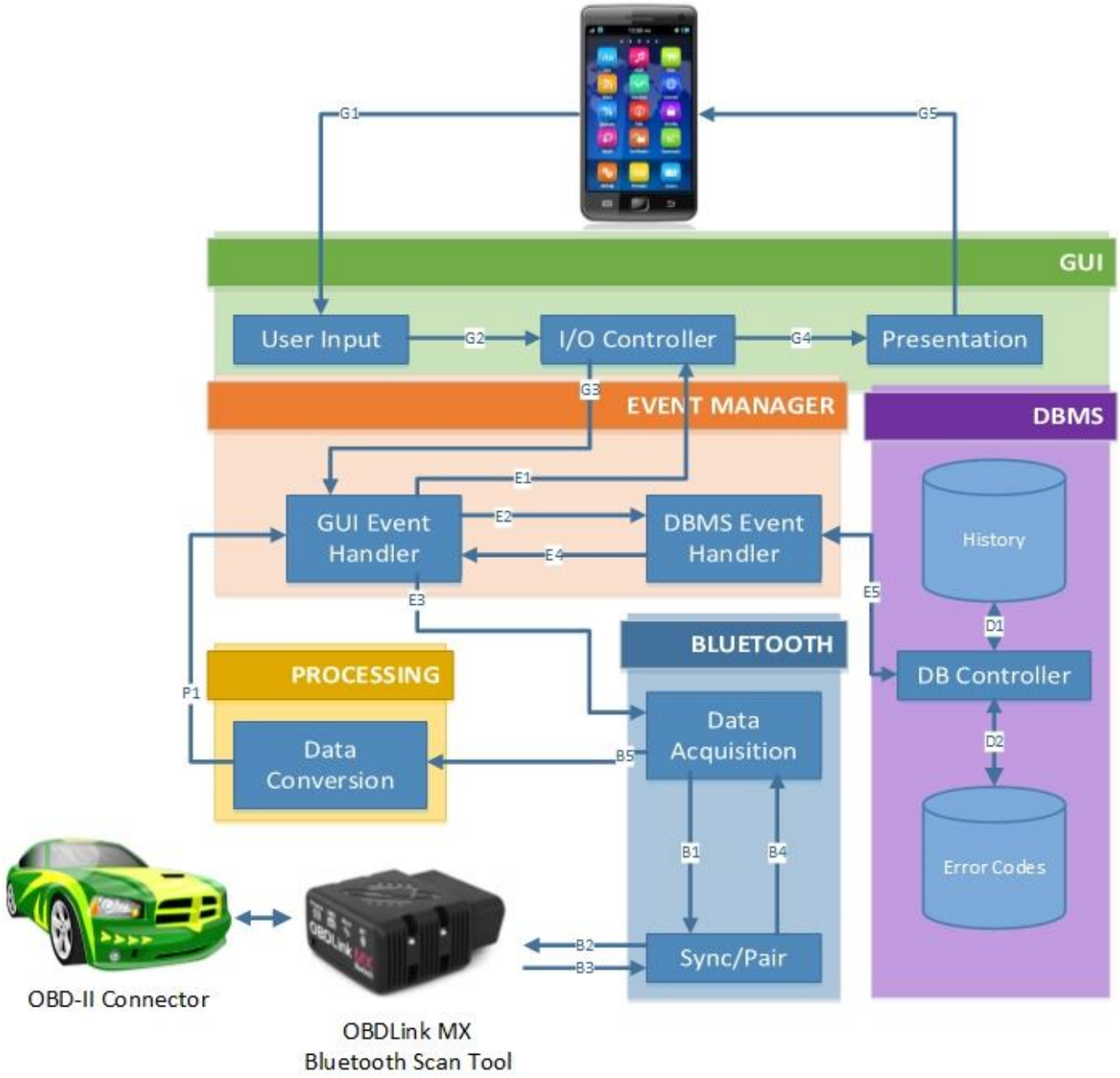


Figure 2 - 1 Architectural diagram of system

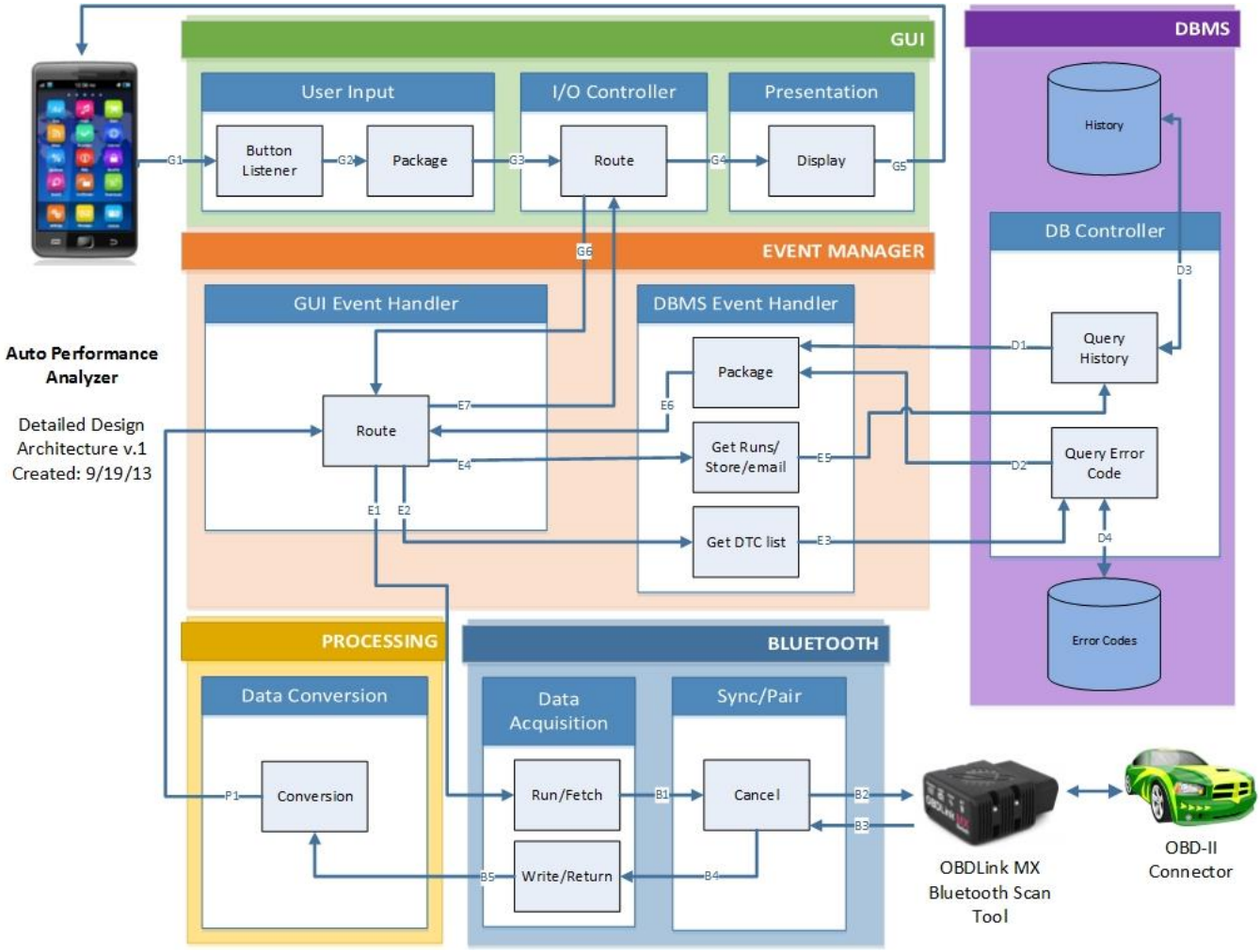


Figure 2 - 2 Detailed Design diagram of system

2.1 GUI Layer Definition

2.1.1 Definition

This layer will get the user's input via the mobile device's screen; pass the parameters list to the Event Management layer. It will also be in charge of displaying the information obtained from the Event Management layer.

2.1.2 Functional Description

The user will select the desired parameters on the mobile device using the provided GUI checklist in the application. Upon completing the parameter desired list, this layer will pass the list to the Event Manager Layer through the I/O controller subsystem. The Event Management layer through the processing handler; will pass the list to the processing layer, to convert such parameters to the corresponding OBD-II commands. The Processing layer will pass the converted command list to the

Bluetooth OBD-II adapter connected to the car's OBD-II port. When the car replies with the actual parameter's information, the Bluetooth layer will send the cars' data back to the Processing layer to be processed. This layer will receive the information from the Event Management layer adapter via the I/O controller subsystem, which then it will passed to the presentation subsystem that will display the info on the mobile device's screen.

2.2 Processing Layer Definition

2.2.1 Definition

The Processing layer will receive the parameters list from the Event Management layer or actual parameter data from the Bluetooth Layer and code/decode the information, and will perform processing and the formatting into decimal form.

2.2.2 Functional Description

Upon receiving the parameters list from the Event Manger layer through the processing handler, the Processing layer will convert this list into a stream of commands that the car's On-board computer can understand, and will pass the converted list to the Bluetooth layer. Then it will get from the same Bluetooth layer the actual car's parameter data; which the Processing layer will convert and process to decimal format that it will be required either to be displayed on the mobile device's screen through the GUI event handler or stored on the database file trough the Data Base controller in the DBMS Layer.

2.3 Event Manager Layer Definition

2.3.1 Definition

The Event Manager layer will be in charge of managing and routing the information obtained from all the other layers except the Bluetooth Layer.

2.3.2 Functional Description

This layer will route the users parameter selection list from the GUI Layer, actual parameters information data from the Processing layer and route the data necessary back to the GUI layer to be displayed in the mobile devices' screen or to be passed to the Storage Management layer to be saved to the spreadsheet file.

2.4 Database Management System Layer Definition

3.4.1 Definition

The Database Management System (DBMS) Layer is responsible for storing the data in a file in the form of a table. This layer will also be responsible for retrieval of the Trouble Code Description information.

2.4.2 Functional Description

After receiving the data from the Event Manager layer, this layer will be responsible for the formatting of the data (if necessary) in a table form (spreadsheet) that will contain the time, parameters reading, and the mobile device sensors reading (such as GPS, Accelerometers, etc. if they are available on the mobile device). This layer will also be responsible for managing and retrieval of the Trouble Code Description database information. The information from this layer will be sent back to the Event Manager Layer, through the DBMS Event Handler, to be passed subsequently to the GUI layer if needed to display it.

2.5 Bluetooth Layer Definition

2.5.1 Definition

The Bluetooth Layer will send and receive data to and from the OBDLink MX Bluetooth Scan Tool. Such data will be passed to the Processing Layer to be processed.

2.5.2 Functional Description

The user's parameter selection list will be received already converted to the right format from the Processing Layer. This list of commands will be transmitted via Bluetooth to the OBDLink MX Bluetooth Scan Tool. When the car's On-board computer responds with the car's actual parameter data, the OBD interface will send the data to back to the application, which will be received by the Bluetooth Layer and passed back to the Processing Layer for processing.

3. GUI Layer - User Input

The User Input subsystem belongs to the GUI Layer. All user inputs will be taken through the Auto Performance Analyzer mobile application via touchscreen. The User Input subsystem will be responsible for handling all inputs from the user through the GUI on the mobile application. Its sole responsibilities are to capture the inputs from the user, create and package a Java class object to send to the I/O Controller. This subsystem contains the following modules: Button Listener, and Package.

Types of inputs include:

- Vehicle information from drop down list(Make/Model/Year)
- List of parameters to be selected via check boxes, monitored, and/or displayed (MPH, RPM, Temperature, etc…)
- User controls (operational and configuration controls)

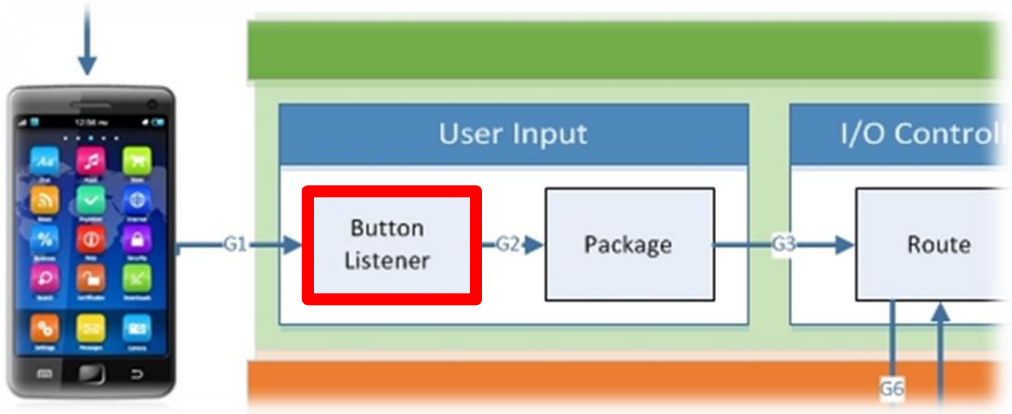


Figure 3 - 1 Button Listener module

3.1 Button Listener

3.1.1 Prologue

This module captures user input once on-screen buttons are pressed. Each button will be programmed to do a specific job (i.e. display next/previous screen, create object, update variables, etc…).

3.1.2 Interfaces

Interfaces	Information Required	Information Returned
• Android Device (touchscreen) • Package(User Input) module	User Input (button pressed)	Captured user inputs

Table 3 - 1 Button Listener module interfaces

3.1.3 External Data Dependencies

External Interfaces – This subsystem will use the mobile device's touchscreen for input.

3.1.4 Internal Data Dependencies

N/A

3.1.5 Psuedo-Code

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
   xmlns:tools="http://schemas.android.com/tools"
   android:layout_width="match_parent"
   android:layout_height="match_parent"
   android:orientation="horizontal">
   <EditText android:id="@+id/edit_message"
      android:layout_weight="1"
      android:layout_width="0dp"
      android:layout_height="wrap_content"
      android:hint="@string/edit_message" />
   <Button
      android:layout_width="wrap_content"
      android:layout_height="wrap_content"
      android:text="@string/button_send" />
</LinearLayout>
```

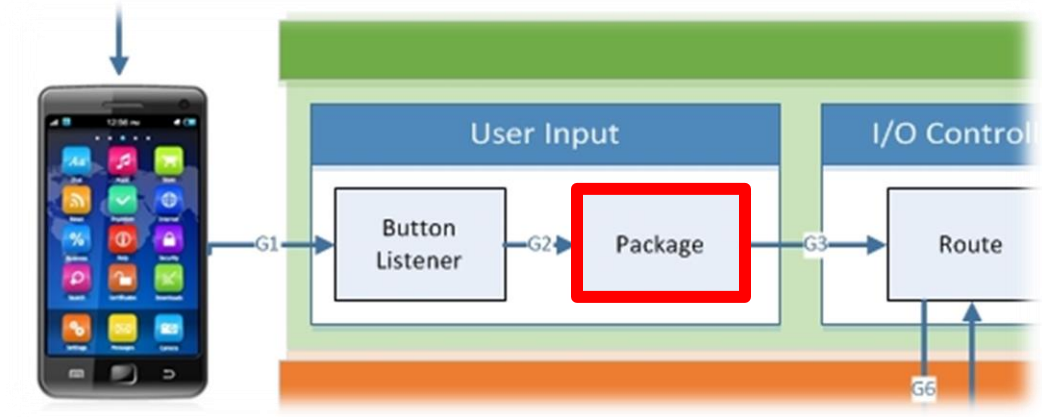


Figure 3 - 2 Package module (User Input)

3.2 Package (User Input)

3.2.1 Prologue

This module will create a Java class object containing a particular vehicle's information stored in various arrays and variables.

3.2.2 Interfaces

Interfaces	Information Required	Information Returned
• Button Listener module • Route (I/O Controller) module	Captured user input	Java class object

Table 3 – 2 Package (User Input) module interfaces

3.2.3 External Data Dependencies

N/A

3.2.4 Internal Data Dependencies

This module requires the captured user input provided by the Button Listener module.

3.2.5 Psuedo-Code

```
public class Run {
        private static int routingFlag
        private Date startTime
        private static String Make
        private static String Model
        private static int Year
        private int Rate
        private int[] Selected_parameters

        public getFlag() {
        }
}
```

4. GUI Layer – I/O Controller

The I/O Controller subsystem belongs to the GUI Layer. This subsystem will determine where the data (Java class object) will eventually go. It will also control the flow of data coming to and from the Event Manager Layer. This subsystem contains the following module(s): Route.

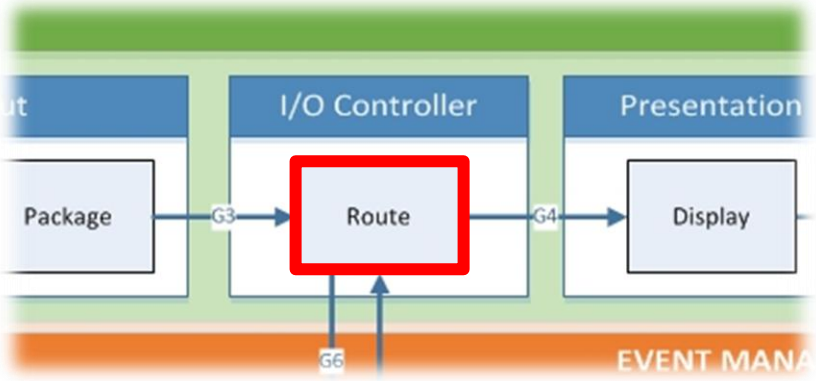


Figure 4 – 1 Route module (I/O Controller)

4.1 Route (I/O Controller)

4.1.1 Prologue

This module will determine where the Java class object will go by reading the flag variable associated with that object. The module will then either pass to the Presentation subsystem or the GUI Event Handler subsystem.

4.1.2 Interfaces

Interfaces	Information Required	Information Returned
• Package(User Input) module • Display module • Route (GUI Event Handler) module	Java class object	Java class object

Table 4 – 1 Route (I/O Controller) module interfaces

4.1.3 External Data Dependencies

Android's library: threads

4.1.4 Internal Data Dependencies

This module is depended on the flag variable that is in the Java Class object.

4.1.5 Psuedo-Code

//check flag

if(flag == 0)

//pass Java class object to Display module

else,

//pass Java class object to Route (GUI Event Handler) module

5. GUI Layer – Presentation

The Presentation subsystem belongs to the GUI Layer. This subsystem's responsibilities are to display the different screens/windows, and populate the list' fields on the device's screen through the Auto Performance Analyzer mobile application. This subsystem contains the following module(s): Display.

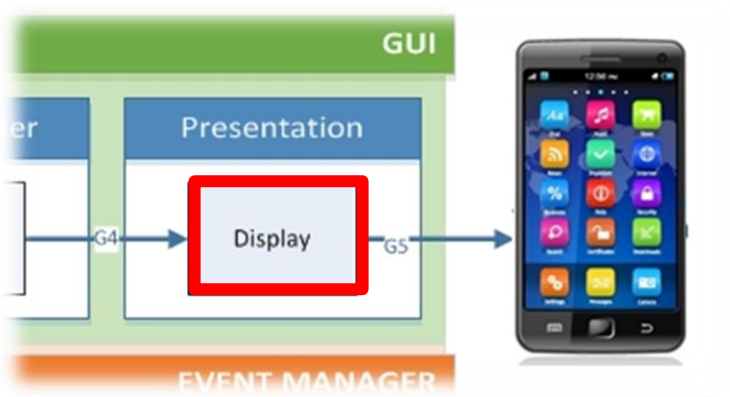


Figure 5 – 1 Display module

5.1 Display

5.1.1 Prologue

This module will display the necessary screens as well as populate the fields (list of parameters and/or DTC) through the Auto Performance Analyzer (APA) mobile application.

5.1.2 Interfaces

Interfaces	Information Required	Information Returned
• Route (I/O Controller) module • Android Device (touchscreen)	Java class object	Java class object

Table 5 – 1 Display module interfaces

5.1.3 External Data Dependencies

External Interfaces – This subsystem will use the mobile device's touchscreen for output.

5.1.4 Internal Data Dependencies

N/A

5.1.5 Psuedo-Code

Produce starting screen with text boxes and button

<?xml version="1.0" encoding="utf-8"?>

<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"

```
   xmlns:tools="http://schemas.android.com/tools"
   android:layout_width="match_parent"
   android:layout_height="match_parent"
   android:orientation="horizontal">
   <EditText android:id="@+id/edit_message"
      android:layout_weight="1"
      android:layout_width="0dp"
      android:layout_height="wrap_content"
      android:hint="@string/edit_message" />
   <Button
      android:layout_width="wrap_content"
      android:layout_height="wrap_content"
      android:text="@string/button_send" />
</LinearLayout>
```

Function to create drop down menu

```
public void addItemsOnSpinner2() {

        spinner2 = (Spinner) findViewById(R.id.spinner2);
        List<String> list = new ArrayList<String>();
        list.add("list 1");
        list.add("list 2");
        list.add("list 3");
        ArrayAdapter<String> dataAdapter = new ArrayAdapter<String>(this,
                android.R.layout.simple_spinner_item, list);
        dataAdapter.setDropDownViewResource(android.R.layout.simple_spinner_dropdown_item);
        spinner2.setAdapter(dataAdapter);
 }
```

Creating Check box parameter display

```
<?xml version="1.0" encoding="utf-8"?>
<LinearLayout xmlns:android="http://schemas.android.com/apk/res/android"
   android:layout_width="fill_parent"
   android:layout_height="fill_parent"
   android:orientation="vertical" >

   <CheckBox
      android:id="@+id/chkIos"
      android:layout_width="wrap_content"
      android:layout_height="wrap_content"
      android:text="@string/chk_ios" />
```

```
    <CheckBox
        android:id="@+id/chkAndroid"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="@string/chk_android"
        android:checked="true" />

    <CheckBox
        android:id="@+id/chkWindows"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="@string/chk_windows" />

    <Button
        android:id="@+id/btnDisplay"
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="@string/btn_display" />

</LinearLayout>
```

6. Event Manager Layer – GUI Event Handler

The GUI Event Handler subsystem belongs to the Event Manager layer. This subsystem handles the flow of data between the GUI, Bluetooth, and the Event Manager layer. This subsystem contains the following module(s): Route.

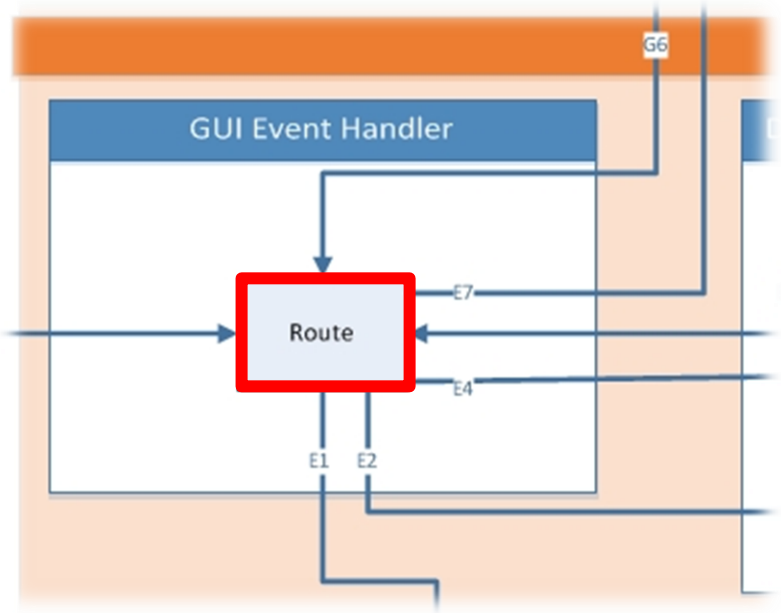


Figure 6 – 1 Route module (GUI Event Handler)

6.1 Route (GUI Event Handler)

6.1.1 Prologue

This routing module is responsible for:

- Determining where the Java class objects needs to go by reading the flag variable associated with that object.
- Returning packaged data from the DBMS Event Handler to the GUI layer.
- Sending hex-code (bytes) directly to the Run/Fetch module in the Bluetooth layer.

6.1.2 Interfaces

Interfaces	Information Required	Information Returned
• Route (I/O Controller) module • Package(DBMS Event Handler) module • Get Runs/Store/E-Mail module • Get DTC List module • Run/Fetch module • Conversion module	Java class object	Updated Java class object

Table 6 – 1 Route (GUI Event Handler) module interfaces

6.1.3 External Data Dependencies

N/A

6.1.4 Internal Data Dependencies

This module requires the flag variable in the Java Class object.

6.1.5 Psuedo-Code

```
// Create a new thread.

class NewThread implements Runnable {

  Thread t;

  NewThread() {

    // Create a new, second thread

    t = new Thread(this, "Demo Thread");

    System.out.println("Child thread: " + t);

    t.start(); // Start the thread

  }
```

7. Event Manager Layer – DBMS Event Handler

The DBMS subsystem belongs to the Event Manager layer. This subsystem will handle all data sent to and from the database. This subsystem contains the following module(s): Package, Get Runs/Store/E-Mail.

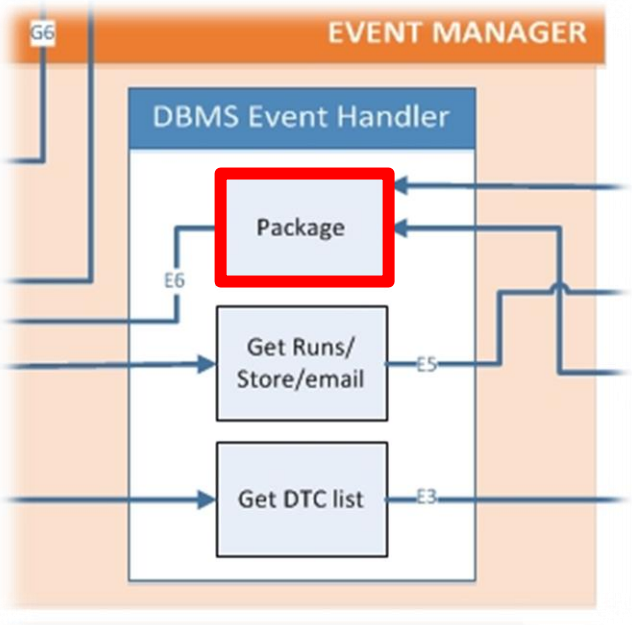


Figure 7 – 1 Package Module (DBMS Event Handler)

7.1 Package (DBMS Event Handler)

7.1.1 Prologue

The Package module enters the data retrieved from the databases into the Java class object, packages it, and returns it to the GUI Event Handler subsystem where it will be routed to its next destination.

7.1.2 Interfaces

Interfaces	Information Required	Information Returned
• Query History module • Query Error Code module • Route (GUI Event Handler) module	• Java class object • Data retrieved from database	Updated Java class object

Table 7 – 1 Package (DBMS Event Handler) module interfaces

7.1.3 External Data Dependencies

N/A

7.1.4 Internal Data Dependencies

This module requires the requested data fetched from either the History database or the Error Code database.

7.1.5 Psuedo-Code

N/A

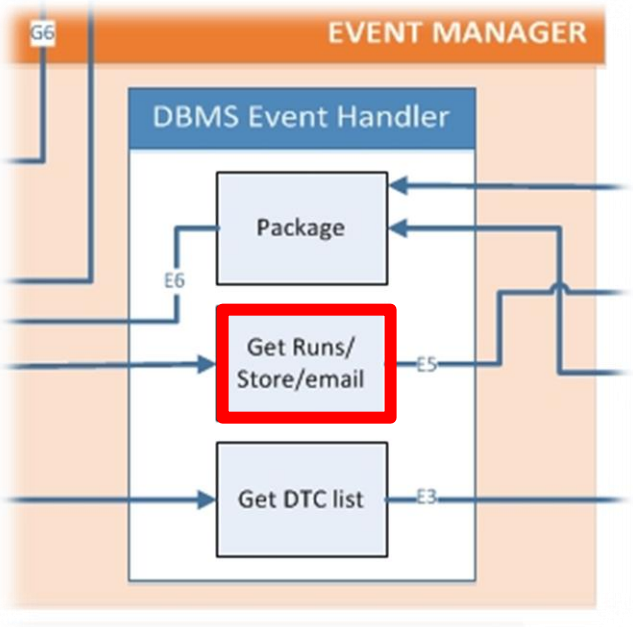


Figure 7 – 2 Get Runs/Store/E-Mail module

7.2 Get Runs/Store/E-mail

7.2.1 Prologue

This module is responsible for:

- Sending the data to be compared and fetched from the history database, such as past runs (also needed for E-Mail)
- Sending data to be stored into the history database (i.e. recording the current run)

7.2.2 Interfaces

Interfaces	Information Required	Information Returned
• Route (GUI Event Handler) module • Query History module	• Java class object • Data query	Updated Java class object

Table 7 – 2 Get Runs/Store/E-Mail module interfaces

7.2.3 External Data Dependencies

N/A

7.2.4 Internal Data Dependencies

N/A

7.2.5 Psuedo-Code

N/A

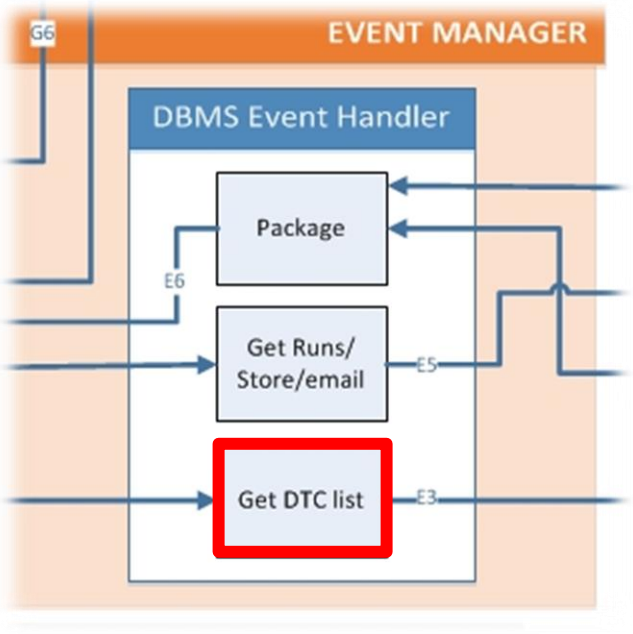


Figure 7 - 3 Get DTC List module

7.3 Get DTC List

7.3.1 Prologue

This module will send selected error code to the DBMS layer for comparison and retrieval of requested data (i.e. make/model/year).

7.3.2 Interfaces

Interfaces	Information Required	Information Returned
• Route (GUI Event Handler) module • Query Error Code module	• Java class object • Data query	Updated Java class object

Table 7 - 3 Get DTC List module interfaces

7.3.3 External Data Dependencies

N/A

7.3.4 Internal Data Dependencies

N/A

7.3.5 Psuedo-Code

N/A

8. Processing Layer – Data Conversion

The Data Conversion Subsystem belongs to the Processing Layer. This subsystem will do the actual conversion calculations that it gets from the Bluetooth adapter. This subsystem contains the following module(s): Conversion.

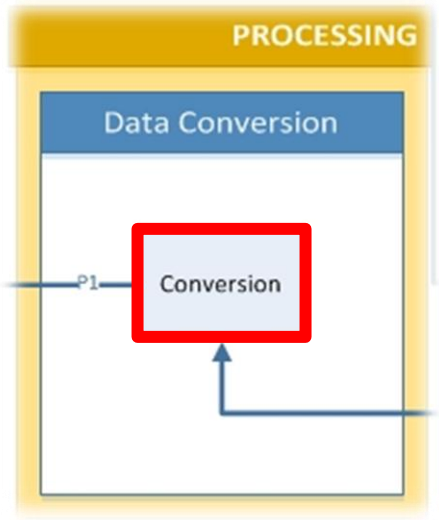


Figure 8 – 1 Conversion module

8.1 Conversion

8.1.1 Prologue

This module's only responsibility is to convert the hex-code it gets from the Bluetooth adapter into integer representation.

8.1.2 Interfaces

Interfaces	Information Required	Information Returned
• Write/Return module • Route (GUI Event Handler) module	• Java class object • Hex-code (bytes)	• Updated Java class object • Integer data type

Table 8 – 1 Conversion module interfaces

8.1.3 External Data Dependencies

N/A

8.1.4 Internal Data Dependencies

In order to do the conversion, this module will require the hex-code (bytes) returned from the Write/Return module.

8.1.5 Psuedo-Code

//Read passed in hex (bytes)

//do conversion from hex to int

```
String hexNumber = #### //where #### is the read in hex-code
int decimal = Integer.parseInt(hexNumber, 16);
```

//reassign variable values

9. Bluetooth Layer - Data Acquisition Subsystem

The Data Acquisition Subsystem belongs to the Bluetooth Layer. This subsystem will work with the mobile device's Bluetooth system to send requests and receive data. This subsystem contains the following module(s): Run/Fetch, and Write/Return.

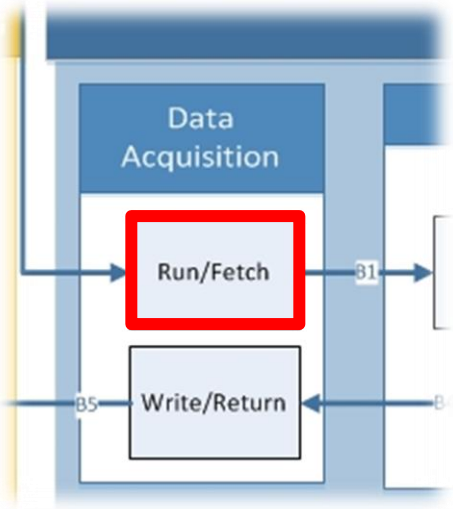


Figure 9 - 1 Run/Fetch module

9.1 Run/Fetch

9.1.1 Prologue

The Run/Fetch module will send data requests to the OBD-II adapter to be fetched.

9.1.2 Interfaces

Interfaces	Information Required	Information Returned
• Route (GUI Event Handler) module • Cancel module	• Java class object • Data query	• Updated Java class object • Data query

Table 9 - 1 Run/Fetch module interfaces

9.1.3 External Data Dependencies

N/A

9.1.4 Internal Data Dependencies

This module requires the hex-code to lookup/fetched passed from the Route (GUI Event Handler) module.

9.1.5 Psuedo-Code

```
/* Call this from the main activity to send data to the remote device */
public void write(byte[] bytes) {
    try {
        mmOutStream.write(bytes);
    } catch (IOException e) { }
}
```

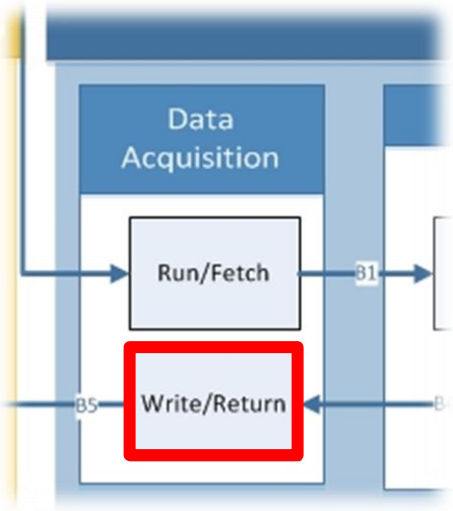


Figure 9 - 2 Write/Return module

9.2 Write/Return

9.2.1 Prologue

This module receives the data it gets from the OBD-II adapter and sends it to the Processing layer, where it will be converted into an integer type.

9.2.2 Interfaces

Interfaces	Information Required	Information Returned
• Cancel module • Conversion module	• Java class object • Hex-code (bytes)	• Updated Java class object • Hex-code

Table 9 - 2 Write/Return module interfaces

9.2.3 External Data Dependencies

N/A

9.2.4 Internal Data Dependencies

N/A

9.2.5 Psuedo-Code

```
public void run() {
      byte[] buffer = new byte[1024];  // buffer store for the stream
      int bytes; // bytes returned from read()

      // Keep listening to the InputStream until an exception occurs
      while (true) {
         try {
            // Read from the InputStream
            bytes = mmInStream.read(buffer);
            // Send the obtained bytes to the UI activity
            mHandler.obtainMessage(MESSAGE_READ, bytes, -1, buffer)
                  .sendToTarget();
         } catch (IOException e) {
            break;
         }
      }
   }
```

10. Bluetooth Layer – Sync/Pair

The Sync/Pair Subsystem belongs to the Bluetooth Layer. Bluetooth synchronization and sustainability will be handled in this subsystem. This subsystem contains the following module(s): Cancel.

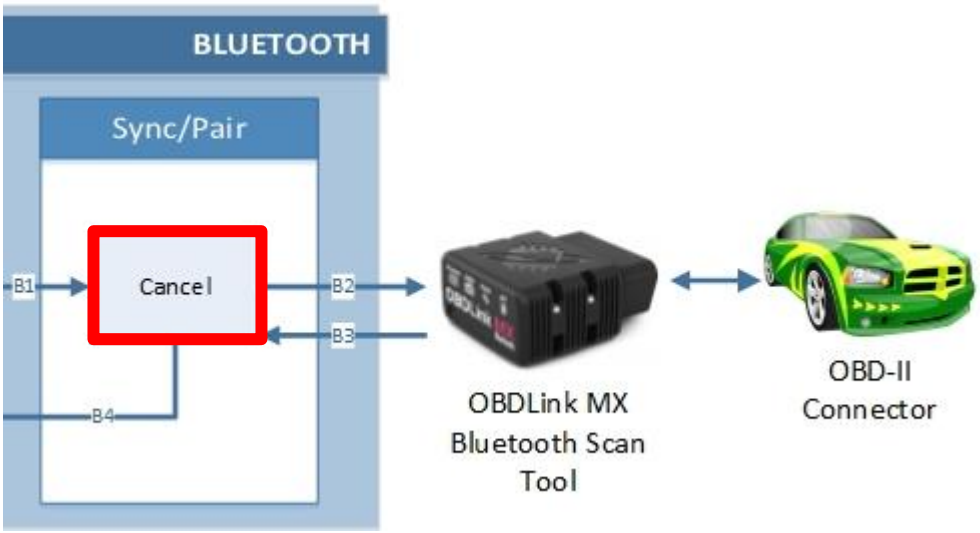


Figure 10 – 1 Cancel module

10.1 Cancel

10.1.1 Prologue

This module will start or terminate the Bluetooth connection as well as maintain the connection.

10.1.2 Interfaces

Interfaces	Information Required	Information Returned
• Run/Fetch module • Bluetooth Adapter (physical component) • Write/Return module	• Java class object • Data query (hex-code)	• Updated Java class object • Requested data (Hex-code)

Table 10 – 1 Cancel module interfaces

10.1.3 External Data Dependencies

External Interfaces – OBDLink MX Bluetooth Scan Tool attached to vehicle's OBD-II Connecter

10.1.4 Internal Data Dependencies

This module depends on the hex-code it is passed on with by the Run/Fetch module.

10.1.5 Psuedo-Code

private class ConnectedThread extends Thread {
private final BluetoothSocket mmSocket;

```
    private final InputStream mmInStream;
    private final OutputStream mmOutStream;

    public ConnectedThread(BluetoothSocket socket) {
        mmSocket = socket;
        InputStream tmpIn = null;
        OutputStream tmpOut = null;

    /* Call this from the main activity to shutdown the connection */
    public void cancel() {
        try {
            mmSocket.close();
        } catch (IOException e) { }
    }
}
```

11. Database Management System – DB Controller

The DB Controller Subsystem belongs to the DBMS Layer. This subsystem will determine where to store the data received as well as locating the desired data. This subsystem contains the following module(s): Query History, and Query Error Code.

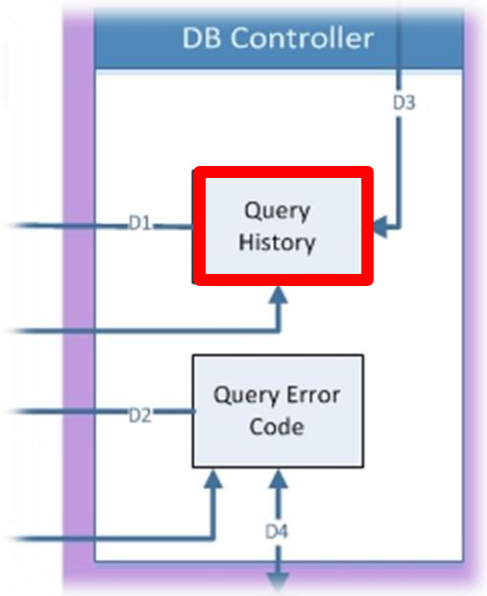


Figure 11 – 1 Query History module

11.1 Query History

11.1.1 Prologue

This module will be required to read/store information from a set of database that contains a list of all previously recorded runs and its associated parameter readings, and vehicle information.

11.1.2 Interfaces

Interfaces	Information Required	Information Returned
• Get Runs/Store/E-Mail module • History database • Package (DBMS Event Handler) module	• Java class object • Data query	• Updated Java class object • Requested data

Table 11 – 1 Query History module interfaces

11.1.3 External Data Dependencies

N/A

11.1.4 Internal Data Dependencies

N/A

11.1.5 Psuedo-Code

```
@Override
        public void onUpgrade(SQLiteDatabase db, int oldVersion, int newVersion) {

        }

    // Add public helper methods to access and get content from the database.
    // Could return cursors by doing "return myDataBase.query(....)" so it'd be easy
    // to create adapters for views.

}
```

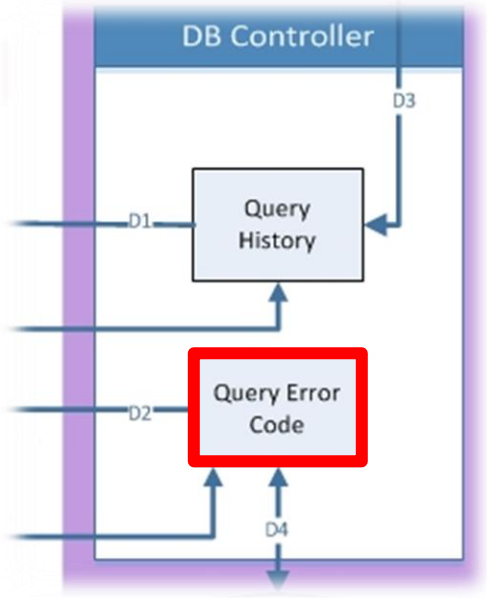


Figure 11 - 2 Query Error Code module

11.2 Query Error Codes

11.2.1 Prologue

This module will query the Error Code database for a particular DTC for comparison. If comparison matches, the module will return the DTC and its corresponding description.

11.2.2 Interfaces

Interfaces	Information Required	Information Returned
• Get DTC List module • Error Code database • Package (DBMS Event Handler) module	• Java class object • Data query	• Updated Java class object • Requested data

Table 11 - 2 Query Error Codes module interfaces

11.2.3 External Data Dependencies

N/A

11.2.4 Internal Data Dependencies

N/A

11.2.5 Psuedo-Code

```
@Override
        public void onUpgrade(SQLiteDatabase db, int oldVersion, int newVersion) {

        }

     // Add public helper methods to access and get content from the database.
    // Could return cursors by doing "return myDataBase.query(....)" so it'd be easy
    // to create adapters for views.

}
```

12. Inter-Components Data Flow

12.1 Overview

Relationship Mapping describes the data flow between each module component of the Auto Performance Analyzer.

12.2 Data Flow Definitions

Table 12-1 (Shown below) provides a description of the data that flows between each module. Data originating from the GUI Layer will begin with a G, Event Manager Layer will begin with E, Processing Layer will begin with P, DBMS Layer will begin with D, and Bluetooth Layer will begin with B.

Layer	Data	Element Description
GUI Layer	G1	Button Pressed
	G2	Send Button event
	G3	Pass object to I/O Controller
	G4	User interface and run object
	G5	Send updated GUI Presentation to Android Device.
	G6	Object
Event Management Layer	E1	Object with parameter list (hex code)
	E2	Object with converted hex DTC (P301) & flag
	E3	Object with converted hex DTC (P301) with fetch instruction
	E4	Object with flag
	E5	Object with fetch/store instructions
	E6	Packaged object
	E7	Return packed object I/O Controller
Processing Layer	P1	Object with converted DTC code or parameters
DBMS Layer	D1	Return fetched object with past runs
	D2	Return fetched Object with DTC (code + description)
	D3	Read, compare, fetch past runs or store info
	D4	Read, compare, fetch DTC (code + description)

Bluetooth Layer	B1	Hex code to be fetched
	B2	Connect to Bluetooth adapter, send hex code, synchronize
	B3	Returns Hex code, maintains connection.
	B4	Returns Hex Code.
	B5	Pass hex code to be converted.

Table 12 - 1 Module Component Data Flow Definitions

12.3 Producer-Consumer Relationship

The producer-consumer relationship is described in Figure 12 – 1 (Shown below). The producer is the source of data element; the consumer is the destination of the data element.

Producer-Consumer Relationship Mapping for Modules Components		Producers																	
		Android Device	**Button Listener**	**Package** (User Input)	**Route** (I/O Controller)	**Display**	**Route** (GUI Event Handler)	**Package** (DBMS Event Handler)	**Get Runs/Store/E-Mail**	**Get DTC List**	**Conversion**	**History** (Database)	**Query History**	**Query Error Code**	**Error Codes** (Database)	**Run/Fetch**	**Write/Return**	**Cancel**	**Bluetooth ODBII Adapter**
Consumers	**Android Device**					G5													
	Button Listener	G1																	
	Package (User Input)		G2																
	Route (I/O Controller)			G3			E7												
	Display				G4														
	Route (GUI Event Handler)				G6			E6			P1								
	Package (DBMS Event Handler)												D1	D2					
	Get Runs/Store/E-Mail						E4												
	Get DTC List						E2												
	Conversion																B5		
	History (Database)												D3						
	Query History								E5			D3							
	Query Error Code									E3					D4				
	Error Codes (Database)													D4					
	Run/Fetch						E1												
	Write/Return																	B4	
	Cancel															B1			B3
	Bluetooth ODBII Module																	B2	

Figure 12 - 1 Producer-Consumer Relationship mapping of Components

13. Quality Assurance

13.1 Test Plans and Procedures

The System Detailed Design will be tested by team Overdrive to verify that the Auto Performance Analyzer fulfills all of the requirements laid out in the System Requirements Specification and in the Architectural Design Specification. Each component and subsystem will be designed to work independently and this independence will allow each module to be tested individually. Then it will be integrated to the final application which then it will be tested again to make sure there will not be integrity issues.

13.2 Module/Unit Testing

13.2.1 GUI Layer

This layer will get the user's input via the mobile device's screen; pass the parameters list to the Event Management layer. It will also be in charge of displaying the information obtained from the Event Manager layer.

User Input Subsystem Test
The tests for this subsystem will verify that the user actions for the buttons will be captured by the application and that this subsystem will create and package a Java class object with the vehicle's information and desired parameters and options to send to the I/O Controller subsystem.

I/O Controller Subsystem Test
This subsystem will be tested by verifying that the object that is passed by the User Input Subsystem will be routed to the destination module which could be either the Mobile Device Screen via the Presentation subsystem or the Event Manager Layer.

Presentation Subsystem Test
The test for the this subsystem will verify that all of the different screens and graphs of the application will show correctly and without distortions of any kind, neither cut portions of the screens when the application is run in devices with a different screen size. The tests will also check that the information will be extracted from the object and populated in the right fields. Additional Tests will verify that the actions from the buttons pressed by the user will be reflected and directed to the proper screens.

13.2.2 Event Manager Layer

The Event Manager layer will be in charge of managing and routing the information obtained from all the other layers.

GUI Event Handler Test
This subsystem will be tested by verifying that the object passed to it from the other layers or subsystems will be directed to the proper destination subsystem, this will include passing the parameter hex code to the Bluetooth Layer

DBMS Event Handler Test
The test for this subsystem will verify that the information obtained from the Database will be packaged and sent to the GUI Layer. Another test will verify that it will send the DTC code to query the database. This will include obtaining information about current runs to be stored in the database or past runs to be read from the database.

13.2.3 Processing Layer

The Processing layer will receive the parameters list from the Event Manager layer or actual parameter data from the Bluetooth Layer and code/decode the information, and will perform processing if necessary and then, formatting the data into decimal form.

Data Conversion Subsystem Test
This subsystem will be tested by making sure that performs the proper conversion from hex form to decimal form, from the bytes passed to it from the Bluetooth Layer.

13.2.4 Bluetooth Layer

The Bluetooth Layer will send and receive data to and from the OBDLink MX Bluetooth Scan Tool. Such data will be passed to the Processing Layer to be processed.

Data Acquisition Subsystem Test
This subsystem will be tested by verifying that sends and receives data from the Bluetooth adapter. The information sent will be the hex code (one byte) for the parameter of interest and the received data will be from one to four bytes of the data for such parameter.

Sync/Pair Subsystem Test

This subsystem will be tested by verifying that the connection will not be interrupted while using the application and the transfer of information between the application and the Bluetooth adapter. The other test will verify that the Bluetooth connection will be properly closed upon exiting the application.

13.2.5 DBMS Layer

The DBMS Layer is responsible for storing and retrieving the data in a spreadsheet or a file in the form of a table or comma separated spreadsheet. This layer will also be responsible for retrieval of the Trouble Code Description information.

DB Controller Subsystem Test

The tests for this subsystem will verify that the vehicle parameter's information will be stored and retrieved from the History database. The other test will make sure that the correct DTC description information will be retrieved from the Error Code Database

13.3 Integration Testing Approach

The Integrity testing will verify proper operation of all of the functions and menus of the Auto Performance Analyzer Application to ensure that it will satisfy all of the requirements from the customer and that it will not be interlayer compatibility issues when integrated to the main application.

13.3.1 GUI Layer Testing

- Verify that any user input and button pressings will be recognized by the User Input Subsystem
- Verify that the vehicle's object information will be passed to the event manager layer
- Verify that the object with the parameters updated received from the event manager layer will be displayed correctly and without noticeable lags in the mobile device's screen
- Verify that the Graphs generated will be rendered accurately in the mobile device's screen

13.3.2 Event Manager Layer

- Verify that the object with the vehicle's parameters will be passed to the GUI Layer and to the DBMS Layer
- Verify that the vehicle's history data will be retrieved from the Data Base Layer and passed to the GUI Layer
- Verify that the parameters hex code will be passed to the Bluetooth layer
- Verify that the converted DTC will be sent to the DBMS Layer

13.3.3 Processing Layer Testing

- Verify that the vehicle's parameter information will be converted from Hex to Decimal
- Verify that the DTC Hex code received from the Bluetooth Layer will be translated to ASCII

13.3.4 Bluetooth Layer

- Verify that the Bluetooth connection is established and not lost during the transfer of data
- Verify that the data is sent to and received from the Bluetooth adapter
- Verify that the Bluetooth connection will be closed when the user exits the application

13.3.5 DBMS Layer

- Verify that the vehicle's actual parameter data will be saved to the History Data Base
- Verify that the vehicle's history parameter data will be retrieved from the History Data Base
- Verify that the vehicle's DTC Information will be retrieved from the Error Code Data Base

13.4 System Verification Testing

13.4.1 GUI Layer Testing

Testing of this layer will verify that the GUI layer will be able to pass the user selection list to the Event Manager layer, and also be able to display the information obtained from the same layer.

13.4.2 Event Manager Layer

This layer will be tested to make sure that it will correctly route the information obtained from the processing layer or the Storage Management layer. Next, that data is properly format for the GUI Layer. Last is that the data is not corrupted when passes to and from the GUI to the Processing Layer and to the DBMS Layer.

13.4.3 Processing Layer Testing

The tests for this layer will verify that receives the parameters list from the GUI layer and translates this list into a command stream of the proper OBD-II codes that will be passed to the Bluetooth layer. There will also be tests that will verify that the data obtained from the car by the Bluetooth layer will be correctly translated to decimal format.

13.4.4 Bluetooth Layer

This layer will be tested within the tests performed for the Processing Layer. That is, it will verify that the application can communicate to the OBD-II adapter and received information from it, and that it will not lose connection to the OBD-II adapter.

13.4.5 DBMS Layer

The tests for this layer will include obtaining the data from the processing layer and verify that the data will preserve its integrity when is formatted and stored in the spreadsheet. Additional tests will be included to verify that the Storage management layer deliver the right information from the Diagnostic Trouble Code database to the GUI layer through the DBMS Handler in the Event Manager Layer.

13.5 Test Cases

Test Case	Expected Result
User Connects Bluetooth Adapter to Car's OBD-II port. Ignition key is off	LEDs on the Bluetooth adapter will not lit
User turns the ignition key to ON position	LEDs on the Bluetooth adapter will blink momentarily and then the power LED will remain lit while the Bluetooth LED will remain blinking and the Activity LED will be off
User pairs the Bluetooth adapter to the mobile device	The power and Bluetooth LEDs will stay lit and the Activity LED will stay off
User Loads the mobile application	The Bluetooth will not be interrupted and the application loads the initial screen
User enters the vehicle's information and selected parameters to monitor	Changes are reflected in the GUI screen and the vehicles information object is created
User records the actual vehicle's parameter data	Vehicle's file is created in the database and the data is saved to the file and displayed in the GUI screen

User stops the recording of the actual vehicle's parameter data	Vehicle's file is closed
User selects a history run	Vehicle's file is retrieved from the History Data Base
User selects the email button	Screen pops up to enter the destination email address and the file is sent
User selects the DTC diagnostic button	The Bluetooth adapter gets the DTC code from the vehicle, the application retrieves the description of the code from Error codes Data Base and is displayed in the mobile device's screen
User selects the Clear DTC button	Clear DTC code is sent to the Bluetooth adapter
User Exits the application	The application closes the Bluetooth connection before closing

Table 13 – 1 Test Cases

14. Requirements Mapping

14.1 Purpose

The purpose of the Requirement Mapping is to give a general overview of the requirements that our team specified in our System Requirements Specification document, and to demonstrate that our System Architecture fully covers and accounts for all of our requirements.

The following table contains all of our architecture related requirements, and for each specific requirement will dictate the layers that are affected by this requirement. If we have designed our system correctly, we should be able to observe that our system is flexible, and fully covers all of our requirements.

14.2 Layer Requirements Traceability

#	Name	GUI Layer	Event Manager Layer	Processing Layer	DBMS Layer	Bluetooth Layer
3.1	Real-Time Data Acquisition			**X**	**X**	**X**
3.2	Performance Mode - Select Readings	**X**	**X**			
3.3	Performance Mode - Monitor	**X**	**X**	**X**		
3.4	Troubleshoot Mode - Vehicle Information	**X**	**X**		**X**	
3.5	Troubleshoot Mode - Comparison	**X**	**X**		**X**	
3.6	Store Readings		**X**		**X**	
3.7	Database (Trouble Codes)				X	
3.8	Database (History)				X	
5.1	Real-Time Output	**X**			**X**	**X**
5.2	Reliable Data Transfer		**X**	**X**	**X**	**X**

Table 14 - 1 Layer Requirements Traceability matrix

14.3 Module Requirements Traceability

	3.1 Real-Time Data Acquisition	3.2 Performance Mode - Select Readings	3.3 Performance Mode - Monitor	3.4 Troubleshoot Mode - Vehicle Information	3.5 Troubleshoot Mode - Comparison	3.6 Store Readings	3.7 Database (Error Code)	3.8 Database (History)	5.1 Real-Time Output	5.2 Reliable Data Transfer
Button Listener		X		X						
Package		X		X						
Route	X		X	X						X
Display		X	X						X	
Route	X	X	X	X		X			X	X
Package		X	X	X		X			X	X
Get Runs/Store/Email	X	X	X			X			X	X
Get DTC list		X			X					X
Query History	X		X			X		X		X
Query Error Code				X	X		X			X
Conversion	X		X						X	X
Run/Fetch	X								X	X
Write/Return	X								X	X
Cancel	X									X

Table 14 - 2 Module Requirements Traceability matrix

15. Acceptance Plan

15.1 Overview

The acceptance plan will outline the minimum requirements that must be fulfilled for the Auto Performance Analyzer (APA) to be accepted as a completed project. These are the requirements mirrored from the System Requirements

15.2 Packaging and Installation

This section describes the packaging requirements for Auto Performance Analyzer (APA). The requirements include the user manual, OBDLink MX Bluetooth Scan Tool, android market submission.

15.2.1 User Manual

- **Description:** The system shall be packaged with a user manual cd explaining how to use APA.
- **Source:** Overdrive
- **Constraints:** The manual will be produced as a pdf file and written in English.
- **Standards:** None
- **Priority:** 1 - Critical

15.2.2 OBDLink MX Bluetooth Scan Tool

- **Description:** The system will include the OBDLink MX Bluetooth Scan Tool.
- **Source:** ScanTool.Net
- **Constraints:** Budget
- **Standards:** Functionality must be tested before packaging.
- **Priority:** 3 - Medium

15.2.3 Android Application Store Submission

- **Description:** APA will be available in the Android Market as a free download.
- **Source:** Overdrive
- **Constraints:** Guidelines to publish an application in the Android Market
- **Standards:** None
- **Priority:** 2- High

15.2.4 OBDLink MX Bluetooth Scan Tool Installation

- **Description:** The quick start guide will include instructions to install the scan tool
- **Source:** Typical location of the vehicle's OBD-II port
- **Constraints:** Vehicle's manufacturers

- **Standards:** None
- **Priority:** 1 - Critical

15.3 Acceptance Testing

The Auto Performance Analyzer will be tested in several ways to verify that it meets the acceptance criteria defined below. These tests will include module, subsystem, layer, integration, and overall system testing. More details on these tests will be provided in the System Test Plan document.

15.4 Acceptance Criteria

15.4.1 GUI Layer

This layer will get the user's input via the mobile device's screen; pass the parameters list to the Event Management layer. It will also be in charge of displaying the information obtained from the Event Manager layer.

User Input Subsystem Acceptance Criteria

After the tests from the model/unit testing are run the acceptance criteria will ensure the Java class object with the vehicle's information and desired parameters and options are packaged correctly before being sent to the I/O controller subsystem.

I/O Controller Subsystem Acceptance Criteria

The acceptance criteria for this layer will ensure that during multiple test runs that the correct flags have been assigned and route the data to the correct module e.g. display module or routing module in the GUI Event handler subsystem.

Presentation Subsystem Acceptance Criteria

The acceptance criteria for this layer will ensure that screens show correct information that is extracted from the object and populated in the right fields. Also the buttons and information entered take the user to the logical next screen.

15.4.2 Event Manager Layer

The Event Manager layer will be in charge of managing and routing the information obtained from all the other layers except the Bluetooth Layer.

GUI Event Handler Acceptance Criteria

The acceptance criteria for this subsystem will ensure that object is routed correctly to the next logically module by the flag assigned in previous modules and include the parameter hex code to the Bluetooth Layer.

DBMS Event Handler Acceptance Criteria

The acceptance criteria for this subsystem is very similar to the GUI event handler subsystem and it will ensure that object are routed correctly to the next logically module by the flag

assigned in previous modules. The acceptance criteria is also ensured by checking the database to ensure that the package data in the Run object is stored correctly after being passed to the query database module.

15.4.3 Processing Layer

The Processing layer will receive the parameters list from the Event Manager layer or actual parameter data from the Bluetooth Layer and code/decode the information, and will perform processing and the formatting into decimal form.

Data Conversion Subsystem Acceptance Criteria

The acceptance criteria for this subsystem will ensure from the bytes passed from Bluetooth module that they are converted correctly from hexadecimal to decimal based on hand calculations.

15.4.4 DBMS Layer

The DBMS Layer is responsible for storing the data in a spreadsheet or a file in the form of a table. This layer will also be responsible for retrieval of the Trouble Code Description information.

DB Controller Subsystem Acceptance Criteria

The acceptance criteria for this subsystem will ensure that the vehicle parameter's information is stored and retrieved correctly from the History database. The other acceptance criteria will ensure that the correct DTC description information is retrieved from the error code database.

15.4.5 Bluetooth Layer

The Bluetooth Layer will send and receive data to and from the Bluetooth Scan Tool. Such data will be passed to the Processing Layer to be processed.

Data Acquisition Subsystem Acceptance Criteria

The acceptance criteria for this subsystem will ensure that the information from the Bluetooth module is the hex code (one byte) for the parameter of interest and the received data is from one to four bytes of the data for such parameter using the simulator to retrieve a known value.

Sync/Pair Subsystem Test

The acceptance criteria for this subsystem will ensure that the connection is not interrupted while using the application and the transfer of information between the application and the Bluetooth adapter. The other acceptance criteria will ensure that the Bluetooth connection is properly closed upon exiting the application and when a run is complete.

16. Hardware Components

16.1 Overview

This section will list the necessary hardware components as well as its purpose, specifications, and interfaces, needed to run the Auto Performance Analyzer mobile application.

16.2 OBDLink MX Bluetooth Scan Tool

16.2.1 Purpose

The purpose of this adapter is to send and retrieve hex-codes from the vehicle's on-board diagnostic (OBD) system.

16.2.2 Specifications

Dimensions	0.91"(23mm) x 1.97"(51mm) x 1.77"(45mm)
Weight	1.2 oz. (33 g.)
Operating Ambient Temperature	-4º to 131º F (-20º to 55º C)
Supply Voltage	7VDC to 40VDC
Operating Voltage	8-18V DC
Operating Humidity	10 to 85% (non-condensing)

Table 16 - 1 Operating Specifications for OBDLink MX Bluetooth Scan Tool

16.2.3 Interfaces

This adapter is connected to the vehicle's OBD-II connector (usually found under the steering wheel).

16.3 Android Device with Bluetooth Capability

16.3.1 Purpose

The Auto Performance Analyzer is an Android application, thus will require an Android device to be able to run the application.

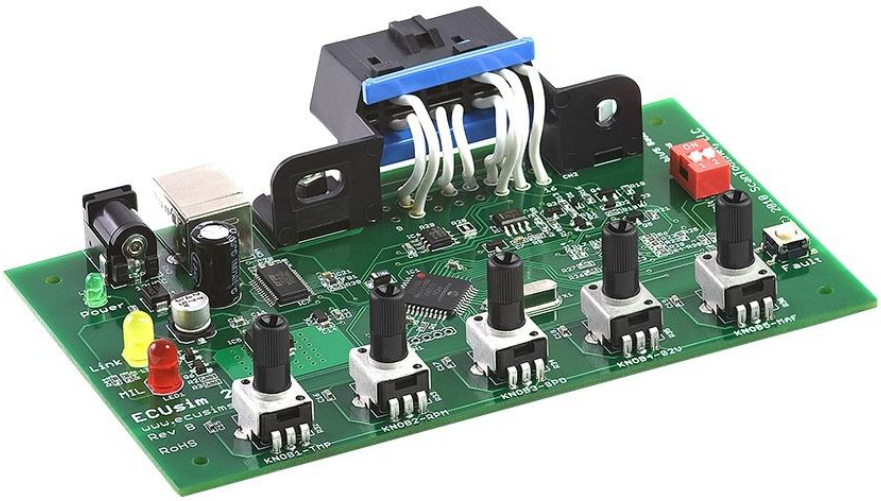
16.3.2 Specifications

Android device with Bluetooth Capability

16.3.3 Interfaces

The Android device will be paired/synchronized with the OBDLink MX Bluetooth Scan Tool, via Bluetooth.

16.4 ECUsim 2000 OBD-II ECU Simulator



16.4.1 Purpose

ECUsim 2000 is a small, lightweight, entry level OBD simulator that is an indispensable tool for OBD hardware and software development and testing. It supports all legislated OBD-II protocols, fixed and user adjustable parameter IDs (PIDs), diagnostic trouble codes (DTCs), freeze frames, VIN, and many other SAE J1979 services.

16.4.2 Specifications

Dimensions	5.0 x 3.0 x 1.12 in (127 x 76.2 x 28.4 mm)
Weight	2.5 oz (70.8 g)
Power	12 VDC @ 2A (max)
OBD Protocols	SAE J1850 PWM SAE J1850 VPW ISO 9141-2 ISO 14230-4 (KWP2000) ISO 15765-4 (CAN 250/500 kbps, 11/29 bit)
PC Port	USB Type B
Operating Temperature	-4° to 131°F (-20° to 55°C)
Operating Humidity	10 to 85%, non-condensing
Storage Temperature	-40° to 185°F (-40° to 85°C)
Storage Humidity	5 to 90% non-condensing

Table 16 - 2 Specifications for ECUsim 2000 OBD-II ECU Simulator

16.4.3 Interfaces

This adapter is connected to a computer or the OBDLink MX Bluetooth Scan Tool.

Appendix A: Acronym/Glossary

APA: Auto Performance Analyzer
Description: An Android mobile application currently in development by team Overdrive.

ADS: Architectural Design Specification

CAN: Controller Area Network
Description: CAN is a serial bus protocol to connect individual systems and sensors as an alternative to conventional multi-wire looms. It allows automotive components to communicate on a single or dual-wire networked data bus up to 1Mbps.

COTS: Commercial off-the-Shelf
Description: An adjective that describes software or hardware products that is ready-made and available for sale to the general public.

DBMS: Database Management System

DDS: Detailed Design Specification

DTC: Diagnostic Trouble Code (Also referred to as Trouble Code or Error Code)
Description: An alphanumeric value that corresponds to a particular type of fault, detected by the OBD system.

ECUsim 2000 OBD-II ECU Simulator
Description: ECUsim 2000 is a small, lightweight, entry level OBD simulator that is an indispensable tool for OBD hardware and software development and testing. It supports all legislated OBD-II protocols, fixed and user adjustable parameter IDs (PIDs), diagnostic trouble codes (DTCs), freeze frames, VIN, and many other SAE J1979 services.

ELM327:
Description: A programmed microcontroller produced by ELM Electronics for translating the on-board diagnostics (OBD) interface found in most modern cars.

GUI: Graphical User Interface

I/O: Input/Output

OBD: On-Board Diagnostic System

OBD-II: On-Board Diagnostics System
Description: Updated On-Board Diagnostics standard effective in cars sold in the US after 1-1-96. OBD-II, a new standard introduced in the mid-'90s, provides almost complete engine control and also monitors parts of the chassis, body and accessory devices, as well as the diagnostic control network of the car.

ISO 9141:
Description: International Standards Organization OBDII communication mode, used by Chrysler and most foreign cars. One of three hardware layers defined by OBD II

J1850PWM:
Description: (Pulse Width Modulated) SAE-established OBD II communication standard used by Ford domestic cars and light trucks. One of three hardware layers defined by OBD II

J1850VPW:
Description: (Variable Pulse Width Modulated) SAE-established OBD II communication standard used by GM cars and light trucks. One of three hardware layers defined by OBD II

Parameters:
Description: Readings on scan tools representing functions measured by OBD II and proprietary readings

PID: Parameter ID

STN1110:
Description: STN1110 is the world's smallest, lowest cost multiprotocol OBD to UART interpreter IC. It provides an easy means of accessing vehicle data, including diagnostic trouble codes, MIL status, VIN, Inspection and Maintenance (I/M) information, In-use Performance Tracking (IPT), and hundreds of real-time parameters. To maintain compatibility with existing applications, STN1110 has full support for the ELM327 command set, while outperforming the original ELM327 IC in every category: stability, performance, and features.

STN1170:
Description: STN1170 combines the entire STN1110 (multiprotocol OBD-II) feature set with Single Wire CAN (SW-CAN) and Medium Speed CAN (MS-CAN) protocols in a single 44-pin IC. SW-CAN protocol support allows your device to access, monitor and issue commands on vehicles utilizing GM's proprietary CAN network. Similarly, MS-CAN provides access to Ford's proprietary CAN network on supporting models.

STN1170 Bluetooth OBD-II Adapter:
Description: The STN1170 Bluetooth OBD-II adapter enables you to read and monitor various sensors built into newer (1996-present) cars, light-trucks, and some heavy-trucks too. The adapter also allows you to read and clear trouble codes from the engine computer to assist in repairing your vehicle to pass emissions tests required by some states.

OBDLink MX Bluetooth Scan Tool
Description: Same functionalities as the STN1170 Bluetooth OBD-II Adapter. The OBDLink MX Bluetooth is the world's fastest on-board diagnostics (OBD) interface that works with all 1996 and newer cars and light trucks sold in the United States.

UART: Universal Asynchronous Receiver/Transmitter

Description: A piece of computer hardware that translates data between parallel and serial forms. Every computer contains a UART to manage the serial ports, and some internal modems have their own UART.

Appendix B: Pseudo-Codes

```
public class DataBaseHelper extends SQLiteOpenHelper{

    //The Android's default system path of your application database.
    private static String DB_PATH = "/data/data/YOUR_PACKAGE/databases/";

    private static String DB_NAME = "myDBName";

    private SQLiteDatabase myDataBase;

    private final Context myContext;

    /**
   * Constructor
   * Takes and keeps a reference of the passed context in order to access to the application assets and
resources.
   * @param context
   */
    public DataBaseHelper(Context context) {

        super(context, DB_NAME, null, 1);
        this.myContext = context;
    }

  /**
   * Creates a empty database on the system and rewrites it with your own database.
   * */
    public void createDataBase() throws IOException{

        boolean dbExist = checkDataBase();

        if(dbExist){
            //do nothing - database already exist
        }else{

            //By calling this method and empty database will be created into the default system path
             //of your application so we are gonna be able to overwrite that database with our database.
        this.getReadableDatabase();

        try {

                copyDataBase();

            } catch (IOException e) {
```

```
                throw new Error("Error copying database");

            }
            }

    }

    /**
   * Check if the database already exist to avoid re-copying the file each time you open the application.
   * @return true if it exists, false if it doesn't
   */
    private boolean checkDataBase(){

        SQLiteDatabase checkDB = null;

        try{
            String myPath = DB_PATH + DB_NAME;
            checkDB = SQLiteDatabase.openDatabase(myPath, null,
SQLiteDatabase.OPEN_READONLY);

        }catch(SQLiteException e){

            //database does't exist yet.

        }

        if(checkDB != null){

            checkDB.close();

        }

        return checkDB != null ? true : false;
    }

    /**
   * Copies database from local assets-folder to the just created empty database in the
   * system folder, from where it can be accessed and handled.
   * This is done by transfering bytestream.
   * */
    private void copyDataBase() throws IOException{

        //Open local db as the input stream
        InputStream myInput = myContext.getAssets().open(DB_NAME);

        // Path to the just created empty db
        String outFileName = DB_PATH + DB_NAME;

        //Open the empty db as the output stream
```

```
            OutputStream myOutput = new FileOutputStream(outFileName);

            //transfer bytes from the inputfile to the outputfile
            byte[] buffer = new byte[1024];
            int length;
            while ((length = myInput.read(buffer))>0){
                  myOutput.write(buffer, 0, length);
            }

            //Close the streams
            myOutput.flush();
            myOutput.close();
            myInput.close();

      }

      public void openDataBase() throws SQLException{

            //Open the database
            String myPath = DB_PATH + DB_NAME;
            myDataBase = SQLiteDatabase.openDatabase(myPath, null,
SQLiteDatabase.OPEN_READONLY);

      }

      @Override
    public synchronized void close() {

                  if(myDataBase != null)
                        myDataBase.close();

                  super.close();

    }

    @Override
    public void onCreate(SQLiteDatabase db) {

    }

    @Override
    public void onUpgrade(SQLiteDatabase db, int oldVersion, int newVersion) {

    }

          // Add public helper methods to access and get content from the database.
          // Return cursors by doing "return myDataBase.query(....)" so it'd be easy
          // to create adapters for views.
```

```
}

// Functionality to use the database
DataBaseHelper myDbHelper = new DataBaseHelper();
myDbHelper = new DataBaseHelper(this);

try {
        myDbHelper.createDataBase();
    } catch (IOException ioe) {
        throw new Error("Unable to create database");
    }
    try {
        myDbHelper.openDataBase();
    }catch(SQLException sqle){
        throw sqle;
    }
```

Appendix C: Generic Diagnostic Trouble Codes

Generic Powertrain Trouble Codes: (P0xxx, P2xxx, P34xx - P39xx)

- P00xx - Fuel and Air Metering and Auxiliary Emission Controls.
- P0100-P0199 – Fuel and Air Metering
- P0200-P0299 – Fuel and Air Metering (Injector Circuit)
- P0300-P0399 – Ignition System or Misfire
- P0400-P0499 – Auxiliary Emissions Controls
- P0500-P0599 – Vehicle Speed Controls and Idle Control System
- P0600-P0699 – Computer Output Circuit
- P0700-P0899 – Transmission

Generic Body Trouble Codes: (B0xxx, B3xxx)

- *(As of 2005, generic body codes have not been completely defined by auto-makers.)

Generic Chassis Codes: (C0xxx, C3xxx)

- *(As of 2005, generic chassis codes have not been completely defined by auto-makers.)

Generic Network Trouble Codes: (U0xxx, U3xxx)

Generic Powertrain Trouble Codes		**Generic Body Trouble Codes *Not completely defined**	
P0001	Fuel Volume Regulator Control Circuit/Open	B0001	PCM Discrete Input Speed Signal Error
P0002	Fuel Volume Regulator Control Circuit Range/Performance	B0004	PCM Discrete Input Speed Signal Not Present
P0003	Fuel Volume Regulator Control Circuit Low	B0005	In Park Switch Circuit Malfunction
P0004	Fuel Volume Regulator Control Circuit High	B0016	RF/Passenger Frontal Deployment Loop (Single Stage or Stage 1) Resistance Low
P0005	Fuel Shutoff Valve "A" Control Circuit/Open	B0017	RF/Passenger Frontal Deployment Loop (Single Stage or Stage 1) Open
P0006	Fuel Shutoff Valve "A" Control Circuit Low	B0018	RF/Passenger Frontal Deployment Loop (Single Stage or Stage 1) Short to Ground/Voltage Out of Range
P0007	Fuel Shutoff Valve "A" Control Circuit High	B0022	LF/Driver Frontal Deployment Loop (Single Stage or Stage 1) Resistance Low
P0008	Engine Position System Performance	B0024	LF/Driver Frontal Deployment Loop (Single Stage or Stage 1) Short to Ground/Voltage Out of Range
P0009	Engine Position System Performance	B0026	LF/Driver Frontal Deployment Loop (Single Stage or Stage 1) Open
P0010	"A" Camshaft Position Actuator Circuit	B0028	RF/Passenger Side Deployment Loop Resistance Low
P0011	"A" Camshaft Position - Timing Over-Advanced or System Performance	B0029	RF/Passenger Side Deployment Loop Open
P0012	"A" Camshaft Position - Timing Over-Retarded	B0030	RF/Passenger Side Deployment Loop Short to Ground/Voltage Out of Range
P0013	"B" Camshaft Position - Actuator Circuit	B0035	ADS Closed/Shorted to Ground
P0014	"B" Camshaft Position - Timing Over-Advanced or System Performance	B0036	ADS Open/Missing/Shorted to Battery
P0015	"B" Camshaft Position - Timing Over-Retarded	B0037	AUX switch closed/shorted to ground
P0016	Crankshaft Position - Camshaft Position Correlation	B0038	AUX switch open/shorted to battery

P0017	Crankshaft Position - Camshaft Position Correlation	B0040	LF/Driver Side Deployment Loop Resistance Low
P0018	Crankshaft Position - Camshaft Position Correlation	B0041	LF/Driver Side Deployment Loop Open
P0019	Crankshaft Position - Camshaft Position Correlation	B0045	LF Side Deploy Loop Short to Ground/Voltage Out of Range
P0020	"A" Camshaft Position Actuator Circuit	B0051	Deployment Commanded
P0021	"A" Camshaft Position - Timing Over-Advanced or System Performance	B0053	Deployment Commanded with Loop Malfunctions Present
P0022	"A" Camshaft Position - Timing Over-Retarded	B0057	RF/Passenger Pretensioner Deployment Loop Resistance Low
P0023	"B" Camshaft Position - Actuator Circuit	B0058	RF/Passenger Pretensioner Deployment Loop Open
P0024	"B" Camshaft Position - Timing Over-Advanced or System Performance	B0059	RF/Passenger Pretensioner Deployment Loop Short to Ground/Voltage Out of Range
P0025	"B" Camshaft Position - Timing Over-Retarded	B0064	LF/Driver Pretensioner Deployment Loop Resistance Low
P0026	Intake Valve Control Solenoid Circuit Range/Performance	B0065	LF/Driver Pretensioner Deployment Loop Open
P0027	Exhaust Valve Control Solenoid Circuit Range/Performance	B0066	LF/Driver Pretensioner Deployment Loop Short to Ground/Voltage Out of Range
P0028	Intake Valve Control Solenoid Circuit Range/Performance	B0073	Supplemental Deployment Loop #1 Resistance Low
P0029	Exhaust Valve Control Solenoid Circuit Range/Performance	B0074	Supplemental Deployment Loop #1 Open
P0030	HO2S Heater Control Circuit	B0075	Supplemental Deployment Loop #1 Short to Ground/Voltage Out of Range
P0031	HO2S Heater Control Circuit Low	B0077	LF/Driver SIS Malfunction
P0032	HO2S Heater Control Circuit High	B0078	RF/Passenger SIS Malfunction
P0033	Turbo Charger Bypass Valve Control Circuit	B0079	Incorrect LF/Driver SIS Installed
P0034	Turbo Charger Bypass Valve Control Circuit Low	B0080	Discard LF/Driver SIS
P0035	Turbo Charger Bypass Valve Control Circuit High	B0081	Incorrect RF/Passenger SIS Installed
P0036	HO2S Heater Control Circuit	B0082	Discard RF/Passenger SIS
P0037	HO2S Heater Control Circuit Low	B0086	Supplemental Deployment Loop #2 Resistance Low
P0038	HO2S Heater Control Circuit High	B0087	Supplemental Deployment Loop #2 Open
P0039	Turbo/Super Charger Bypass Valve Control Circuit Range/Performance	B0088	Supplemental Deployment Loop #2 Short to Ground/Voltage Out of Range
P0040	O2 Sensor Signals Swapped Bank 1 Sensor 1/ Bank 2 Sensor 1	B0090	Active switch voltage out of range
P0041	O2 Sensor Signals Swapped Bank 1 Sensor 2/ Bank 2 Sensor 2	B0091	Active switch: wrong state
P0042	HO2S Heater Control Circuit	B0092	PPS passenger detection error
P0043	HO2S Heater Control Circuit Low	B0093	PPS/CPS self-test malfunction
P0044	HO2S Heater Control Circuit High	B0094	CPS childseat detection error
P0045	Turbo/Super Charger Boost Control Solenoid Circuit/Open	B0095	SDM-PPS/CPS mismatch malfunction
P0046	Turbo/Super Charger Boost Control Solenoid Circuit Range/Performance	B0126	Right Panel Discharge Temperature Fault
P0047	Turbo/Super Charger Boost Control Solenoid Circuit Low	B0131	Right Heater Discharge Temperature Fault
P0048	Turbo/Super Charger Boost Control Solenoid Circuit High	B0159	Outside Air Temperature Sensor Circuit Range/Performance
P0049	Turbo/Super Charger Turbine Overspeed	B0164	Passenger Compartment Temperature Sensor #1 (Single Sensor or LH) Circuit Range/Performance
P0050	HO2S Heater Control Circuit	B0169	In-car Temp Sensor Failure (passenger -not used)
P0051	HO2S Heater Control Circuit Low	B0174	Output Air Temperature Sensor #1 (Upper; Single or LH) Circuit Range/Performance
P0052	HO2S Heater Control Circuit High	B0179	Output Air Temperature Sensor #2 (Lower; Single or LH) Circuit Range/Performance
P0053	HO2S Heater Resistance	B0184	Solar Load Sensor #1 CKT Range
P0054	HO2S Heater Resistance	B0189	Solar Load Sensor #2 CKT Range
P0055	HO2S Heater Resistance	B0248	Mode Door Inoperative Error
P0056	HO2S Heater Control Circuit	B0249	Heater/Defrost/AC Door Range Error
P0057	HO2S Heater Control Circuit Low	B0268	A/I Door Inoperative Error
P0058	HO2S Heater Control Circuit High	B0269	Air Inlet Door Range Error
P0059	HO2S Heater Resistance	B0408	Temperature Control #1 (Main/Front) Circuit Malfunction
P0060	HO2S Heater Resistance	B0409	Air Mix Door #1 Range Error
P0061	HO2S Heater Resistance	B0419	Air Mix Door #2 Range Error
P0062	HO2S Heater Control Circuit	B0423	Air Mix Door #2 Inoperative Error
P0063	HO2S Heater Control Circuit Low	B0428	Air Mix Door #3 Inoperative Error
P0064	HO2S Heater Control Circuit High	B0429	Temperature Control #3 Rear Circuit Range/Performance
P0065	Air Assisted Injector Control Range/Performance	B0510	RH Panel Discharge Temp Sensor Failure
P0066	Air Assisted Injector Control Circuit or Circuit Low	B0515	RH Heater Discharge Temp Sensor Failure
P0067	Air Assisted Injector Control Circuit High	B0520	Rear Discharge Temp Sensor Failure
P0068	MAP/MAF - Throttle Position Correlation	B0530	Fuel Level Sensor Stuck
P0069	Manifold Absolute Pressure - Barometric Pressure Correlation	B0532	Fuel Sensor Shorted To Ground
P0070	Ambient Air Temperature Sensor Circuit	B0533	Fuel Sensor Open/Shorted To B+
P0071	Ambient Air Temperature Sensor Range/Performance	B0688	Security System Indicator Circuit High
P0072	Ambient Air Temperature Sensor Circuit Low	B0768	Service Indicator Circuit High

P0073	Ambient Air Temperature Sensor Circuit High
P0074	Ambient Air Temperature Sensor Circuit Intermittent
P0075	Intake Valve Control Solenoid Circuit
P0076	Intake Valve Control Solenoid Circuit Low
P0077	Intake Valve Control Solenoid Circuit High
P0078	Exhaust Valve Control Solenoid Circuit
P0079	Exhaust Valve Control Solenoid Circuit Low
P0080	Exhaust Valve Control Solenoid Circuit High
P0081	Intake Valve Control Solenoid Circuit
P0082	Intake Valve Control Solenoid Circuit Low
P0083	Intake Valve Control Solenoid Circuit High
P0084	Exhaust Valve Control Solenoid Circuit
P0085	Exhaust Valve Control Solenoid Circuit Low
P0086	Exhaust Valve Control Solenoid Circuit High
P0087	Fuel Rail/System Pressure - Too Low
P0088	Fuel Rail/System Pressure - Too High
P0089	Fuel Pressure Regulator 1 Performance
P0090	Fuel Pressure Regulator 1 Control Circuit
P0091	Fuel Pressure Regulator 1 Control Circuit Low
P0092	Fuel Pressure Regulator 1 Control Circuit High
P0093	Fuel System Leak Detected - Large Leak
P0094	Fuel System Leak Detected - Small Leak
P0095	Intake Air Temperature Sensor 2 Circuit
P0096	Intake Air Temperature Sensor 2 Circuit Range/Performance
P0097	Intake Air Temperature Sensor 2 Circuit Low
P0098	Intake Air Temperature Sensor 2 Circuit High
P0099	Intake Air Temperature Sensor 2 Circuit Intermittent/Erratic
DTC Codes - P0100-P0199 – Fuel and Air Metering	
DTC	Description
P0100	Mass or Volume Air Flow Circuit Malfunction
P0101	Mass or Volume Air Flow Circuit Range/Performance Problem
P0102	Mass or Volume Air Flow Circuit Low Input
P0103	Mass or Volume Air Flow Circuit High Input
P0104	Mass or Volume Air Flow Circuit Intermittent
P0105	Manifold Absolute Pressure/Barometric Pressure Circuit Malfunction
P0106	Manifold Absolute Pressure/Barometric Pressure Circuit Range/Performance Problem
P0107	Manifold Absolute Pressure/Barometric Pressure Circuit Low Input
P0108	Manifold Absolute Pressure/Barometric Pressure Circuit High Input
P0109	Manifold Absolute Pressure/Barometric Pressure Circuit Intermittent
P0109	Intake Air Temperature Circuit Malfunction
P0111	Intake Air Temperature Circuit Range/Performance Problem
P0112	Intake Air Temperature Circuit Low Input
P0113	Intake Air Temperature Circuit High Input
P0114	Intake Air Temperature Circuit Intermittent
P0115	Engine Coolant Temperature Circuit Malfunction
P0116	Engine Coolant Temperature Circuit Range/Performance Problem
P0117	Engine Coolant Temperature Circuit Low Input
P0118	Engine Coolant Temperature Circuit High Input
P0119	Engine Coolant Temperature Circuit Intermittent
P0120	Throttle/Petal Position Sensor/Switch A Circuit Malfunction
P0121	Throttle/Petal Position Sensor/Switch A Circuit Range/Performance Problem
P0122	Throttle/Petal Position Sensor/Switch A Circuit Low Input
P0123	Throttle/Petal Position Sensor/Switch A Circuit High Input
P0124	Throttle/Petal Position Sensor/Switch A Circuit Intermittent
P0125	Insufficient Coolant Temperature for Closed Loop Fuel Control
P0126	Insufficient Coolant Temperature for Stable Operation
P0130	02 Sensor Circuit Malfunction (Bank I Sensor 1)
P0131	02 Sensor Circuit Low Voltage (Bank I Sensor I)

B0846	+5 Volt Reference Out of Range
B0856	Battery 2 Out of Range
Generic Chassis Codes *Not completely defined	
Generic Network Trouble Codes	
U0001	High Speed CAN Communication Bus
U0002	High Speed CAN Communication Bus Performance
U0003	High Speed CAN Communication Bus (+) Open
U0004	High Speed CAN Communication Bus (+) Low
U0005	High Speed CAN Communication Bus (+) High
U0006	High Speed CAN Communication Bus (-) Open
U0007	High Speed CAN Communication Bus (-) Low
U0008	High Speed CAN Communication Bus (-) High
U0009	High Speed CAN Communication Bus (-) shorted to Bus (+)
U0010	Medium Speed CAN Communication Bus
U0011	Medium Speed CAN Communication Bus Performance
U0012	Medium Speed CAN Communication Bus (+) Open
U0013	Medium Speed CAN Communication Bus (+) Low
U0014	Medium Speed CAN Communication Bus (+) High
U0015	Medium Speed CAN Communication Bus (-) Open
U0016	Medium Speed CAN Communication Bus (-) Low
U0017	Medium Speed CAN Communication Bus (-) High
U0018	Medium Speed CAN Communication Bus (-) shorted to Bus (+)
U0019	Low Speed CAN Communication Bus
U0020	Low Speed CAN Communication Bus Performance
U0021	Low Speed CAN Communication Bus (+) Open
U0022	Low Speed CAN Communication Bus (+) Low
U0023	Low Speed CAN Communication Bus (+) High
U0024	Low Speed CAN Communication Bus (-) Open
U0025	Low Speed CAN Communication Bus (-) Low
U0026	Low Speed CAN Communication Bus (-) High
U0027	Low Speed CAN Communication Bus (-) shorted to Bus (+)
U0028	Vehicle Communication Bus A
U0029	Vehicle Communication Bus A Performance
U0030	Vehicle Communication Bus A (+) Open
U0031	Vehicle Communication Bus A (+) Low
U0032	Vehicle Communication Bus A (+) High
U0033	Vehicle Communication Bus A (-) Open
U0034	Vehicle Communication Bus A (-) Low
U0035	Vehicle Communication Bus A (-) High
U0036	Vehicle Communication Bus A (-) shorted to Bus A (+)
U0037	Vehicle Communication Bus B
U0038	Vehicle Communication Bus B Performance
U0039	Vehicle Communication Bus B (+) Open
U0040	Vehicle Communication Bus B (+) Low
U0041	Vehicle Communication Bus B (+) High
U0042	Vehicle Communication Bus B (-) Open
U0043	Vehicle Communication Bus B (-) Low
U0044	Vehicle Communication Bus B (-) High
U0045	Vehicle Communication Bus B (-) shorted to Bus B (+)
U0046	Vehicle Communication Bus C
U0047	Vehicle Communication Bus C Performance
U0048	Vehicle Communication Bus C (+) Open
U0049	Vehicle Communication Bus C (+) Low
U0050	Vehicle Communication Bus C (+) High
U0051	Vehicle Communication Bus C (-) Open
U0052	Vehicle Communication Bus C (-) Low

P0132	02 Sensor Circuit High Voltage (Bank I Sensor 1)	U0053	Vehicle Communication Bus C (-) High
P0133	02 Sensor Circuit Slow Response (Bank 1 Sensor 1)	U0054	Vehicle Communication Bus C (-) shorted to Bus C (+)
P0134	02 Sensor Circuit No Activity Detected (Bank I Sensor 1)	U0055	Vehicle Communication Bus D
P0135	02 Sensor Heater Circuit Malfunction (Bank 1 Sensor 1)	U0056	Vehicle Communication Bus D Performance
P0136	02 Sensor Circuit Malfunction (Bank I Sensor 2)	U0057	Vehicle Communication Bus D (+) Open
P0137	02 Sensor Circuit Low Voltage (Bank I Sensor 2)	U0058	Vehicle Communication Bus D (+) Low
P0138	02 Sensor Circuit High Voltage (Bank I Sensor 2)	U0059	Vehicle Communication Bus D (+) High
P0139	02 Sensor Circuit Slow Response (Bank 1 Sensor 2)	U0060	Vehicle Communication Bus D (-) Open
P0140	02 Sensor Circuit No Activity Detected (Bank 1 Sensor 2)	U0061	Vehicle Communication Bus D (-) Low
P0141	02 Sensor Heater Circuit Malfunction (Bank 1 Sensor 2)	U0062	Vehicle Communication Bus D (-) High
P0142	02 Sensor Circuit Malfunction (Bank I Sensor 3)	U0063	Vehicle Communication Bus D (-) shorted to Bus D (+)
P0143	02 Sensor Circuit Low Voltage (Bank I Sensor 3)	U0064	Vehicle Communication Bus E
P0144	02 Sensor Circuit High Voltage (Bank I Sensor 3)	U0065	Vehicle Communication Bus E Performance
P0145	02 Sensor Circuit Slow Response (Bank 1 Sensor 3)	U0066	Vehicle Communication Bus E (+) Open
P0146	02 Sensor Circuit No Activity Detected (Bank I Sensor 3)	U0067	Vehicle Communication Bus E (+) Low
P0147	02 Sensor Heater Circuit Malfunction (Bank I Sensor 3)	U0068	Vehicle Communication Bus E (+) High
P0150	02 Sensor Circuit Malfunction (Bank 2 Sensor I)	U0069	Vehicle Communication Bus E (-) Open
P0151	02 Sensor Circuit Low Voltage (Bank 2 Sensor I)	U0070	Vehicle Communication Bus E (-) Low
P0152	02 Sensor Circuit High Voltage (Bank 2 Sensor 1)	U0071	Vehicle Communication Bus E (-) High
P0153	02 Sensor Circuit Slow Response (Bank 2 Sensor 1)	U0072	Vehicle Communication Bus E (-) shorted to Bus E (+)
P0154	02 Sensor Circuit No Activity Detected (Bank 2 Sensor 1)	U0073	Control Module Communication Bus Off
P0155	02 Sensor Heater Circuit Malfunction (Bank 2 Sensor 1)	U0074	Reserved by Document
P0156	02 Sensor Circuit Malfunction (Bank 2 Sensor 2)	U0075	Reserved by Document
P0157	02 Sensor Circuit Low Voltage (Bank 2 Sensor 2)	U0076	Reserved by Document
P0158	02 Sensor Circuit High Voltage (Bank 2 Sensor 2)	U0077	Reserved by Document
P0159	02 Sensor Circuit Slow Response (Bank 2 Sensor 2)	U0078	Reserved by Document
P0160	02 Sensor Circuit No Activity Detected (Bank 2 Sensor 2)	U0079	Reserved by Document
P0161	02 Sensor Heater Circuit Malfunction (Bank 2 Sensor 2)	U0080	Reserved by Document
P0162	02 Sensor Circuit Malfunction (Bank 2 Sensor 3)	U0081	Reserved by Document
P0163	02 Sensor Circuit Low Voltage (Bank 2 Sensor 3)	U0082	Reserved by Document
P0164	02 Sensor Circuit High Voltage (Bank 2 Sensor 3)	U0083	Reserved by Document
P0165	02 Sensor Circuit Slow Response (Bank 2 Sensor 3)	U0084	Reserved by Document
P0166	02 Sensor Circuit No Activity Detected (Bank 2 Sensor 3)	U0085	Reserved by Document
P0167	02 Sensor Heater Circuit Malfunction (Bank 2 Sensor 3)	U0086	Reserved by Document
P0170	Fuel Trim Malfunction (Bank 1)	U0087	Reserved by Document
P0171	System too Lean (Bank 1)	U0088	Reserved by Document
P0172	System too Rich (Bank 1)	U0089	Reserved by Document
P0173	Fuel Trim Malfunction (Bank 2)	U0090	Reserved by Document
P0174	System too Lean (Bank 2)	U0091	Reserved by Document
P0175	System too Rich (Bank 2)	U0092	Reserved by Document
P0176	Fuel Composition Sensor Circuit Malfunction	U0093	Reserved by Document
P0177	Fuel Composition Sensor Circuit Range/Performance	U0094	Reserved by Document
P0178	Fuel Composition Sensor Circuit Low Input	U0095	Reserved by Document
P0179	Fuel Composition Sensor Circuit High Input	U0096	Reserved by Document
P0180	Fuel Temperature Sensor A Circuit Malfunction	U0097	Reserved by Document
P0181	Fuel Temperature Sensor A Circuit Range/Performance	U0098	Reserved by Document
P0182	Fuel Temperature Sensor A Circuit Low Input	U0099	Reserved by Document
P0183	Fuel Temperature Sensor A Circuit High Input	U0100	Lost Communication With ECM/PCM "A"
P0184	Fuel Temperature Sensor A Circuit Intermittent	U0101	Lost Communication with TCM
P0185	Fuel Temperature Sensor B Circuit Malfunction	U0102	Lost Communication with Transfer Case Control Module
P0186	Fuel Temperature Sensor B Circuit Range/Performance	U0103	Lost Communication With Gear Shift Module
P0187	Fuel Temperature Sensor B Circuit Low Input	U0104	Lost Communication With Cruise Control Module
P0188	Fuel Temperature Sensor B Circuit High Input	U0105	Lost Communication With Fuel Injector Control Module
P0189	Fuel Temperature Sensor B Circuit Intermittent	U0106	Lost Communication With Glow Plug Control Module
P0190	Fuel Rail Pressure Sensor Circuit Malfunction	U0107	Lost Communication With Throttle Actuator Control Module
P0191	Fuel Rail Pressure Sensor Circuit Range/Performance	U0108	Lost Communication With Alternative Fuel Control Module
P0192	Fuel Rail Pressure Sensor Circuit Low Input	U0109	Lost Communication With Fuel Pump Control Module
P0193	Fuel Rail Pressure Sensor Circuit High Input	U0110	Lost Communication With Drive Motor Control Module
P0194	Fuel Rail Pressure Sensor Circuit Intermittent	U0111	Lost Communication With Battery Energy Control Module "A"
P0195	Engine Oil Temperature Sensor Malfunction	U0112	Lost Communication With Battery Energy Control Module "B"
P0196	Engine Oil Temperature Sensor Range/Performance	U0113	Lost Communication With Emissions Critical Control Information
P0197	Engine Oil Temperature Sensor Low	U0114	Lost Communication With Four-Wheel Drive Clutch Control Module
P0198	Engine Oil Temperature Sensor High	U0115	Lost Communication With ECM/PCM "B"
P0199	Engine Oil Temperature Sensor Intermittent	U0116	Reserved by Document

		U0117	Reserved by Document
DTC Codes - P0200-P0299 – Fuel and Air Metering (Injector Circuit)		U0118	Reserved by Document
		U0119	Reserved by Document
P0200	Injector Circuit Malfunction	U0120	Reserved by Document
P0201	Injector Circuit Malfunction - Cylinder 1	U0121	Lost Communication With Anti-Lock Brake System (ABS) Control Module
P0202	Injector Circuit Malfunction - Cylinder 2	U0122	Lost Communication With Vehicle Dynamics Control Module
P0203	Injector Circuit Malfunction - Cylinder 3	U0123	Lost Communication With Yaw Rate Sensor Module
P0204	Injector Circuit Malfunction - Cylinder 4	U0124	Lost Communication With Lateral Acceleration Sensor Module
P0205	Injector Circuit Malfunction - Cylinder 5	U0125	Lost Communication With Multi-axis Acceleration Sensor Module
P0206	Injector Circuit Malfunction - Cylinder 6	U0126	Lost Communication With Steering Angle Sensor Module
P0207	Injector Circuit Malfunction - Cylinder 7	U0127	Lost Communication With Tire Pressure Monitor Module
P0208	Injector Circuit Malfunction - Cylinder 8	U0128	Lost Communication With Park Brake Control Module
P0209	Injector Circuit Malfunction - Cylinder 9	U0129	Lost Communication With Brake System Control Module
P0210	Injector Circuit Malfunction - Cylinder 10	U0130	Lost Communication With Steering Effort Control Module
P0211	Injector Circuit Malfunction - Cylinder 11	U0131	Lost Communication With Power Steering Control Module
P0212	Injector Circuit Malfunction - Cylinder 12	U0132	Lost Communication With Ride Level Control Module
P0213	Cold Start Injector 1 Malfunction	U0133	Reserved by Document
P0214	Cold Start Injector 2 Malfunction	U0134	Reserved by Document
P0215	Engine Shutoff Solenoid Malfunction	U0135	Reserved by Document
P0216	Injection Timing Control Circuit Malfunction	U0136	Reserved by Document
P0217	Engine Overtemp Condition	U0137	Reserved by Document
P0218	Transmission Over Temperature Condition	U0138	Reserved by Document
P0219	Engine Overspeed Condition	U0139	Reserved by Document
P0220	Throttle/Petal Position Sensor/Switch B Circuit Malfunction	U0140	Lost Communication With Body Control Module
P0221	Throttle/Petal Position Sensor/Switch B Circuit Range/Performance Problem	U0141	Lost Communication With Body Control Module "A"
P0222	Throttle/Petal Position Sensor/Switch B Circuit Low Input	U0142	Lost Communication With Body Control Module "B"
P0223	Throttle/Petal Position Sensor/Switch B Circuit High Input	U0143	Lost Communication With Body Control Module "C"
P0224	Throttle/Petal Position Sensor/Switch B Circuit Intermittent	U0144	Lost Communication With Body Control Module "D"
P0225	Throttle/Petal Position Sensor/Switch C Circuit Malfunction	U0145	Lost Communication With Body Control Module "E"
P0226	Throttle/Petal Position Sensor/Switch C Circuit Range/Performance Problem	U0146	Lost Communication With Gateway "A"
P0227	Throttle/Petal Position Sensor/Switch C Circuit Low Input	U0147	Lost Communication With Gateway "B"
P0228	Throttle/Petal Position Sensor/Switch C Circuit High Input	U0148	Lost Communication With Gateway "C"
P0229	Throttle/Petal Position Sensor/Switch C Circuit Intermittent	U0149	Lost Communication With Gateway "D"
P0230	Fuel Pump Primary Circuit Malfunction	U0150	Lost Communication With Gateway "E"
P0231	Fuel Pump Secondary Circuit Low	U0151	Lost Communication With Restraints Control Module
P0232	Fuel Pump Secondary Circuit High	U0152	Lost Communication With Side Restraints Control Module
P0233	Fuel Pump Secondary Circuit Intermittent	U0153	Lost Communication With Side Restraints Control Module
P0234	Engine Overboost Condition	U0154	Lost Communication With Restraints Occupant Sensing Control Module
P0235	Turbocharger Boost Sensor A Circuit Malfunction	U0155	Lost Communication With Instrument Panel Cluster (IPC) Control Module
P0236	Turbocharger Boost Sensor A Circuit Range/Performance	U0156	Lost Communication With Information Center "A"
P0237	Turbocharger Boost Sensor A Circuit Low	U0157	Lost Communication With Information Center "B"
P0238	Turbocharger Boost Sensor A Circuit High	U0158	Lost Communication With Head Up Display
P0239	Turbocharger Boost Sensor B Malfunction	U0159	Lost Communication With Parking Assist Control Module
P0240	Turbocharger Boost Sensor B Circuit Range/Performance	U0160	Lost Communication With Audible Alert Control Module
P0241	Turbocharger Boost Sensor B Circuit Low	U0161	Lost Communication With Compass Module
P0242	Turbocharger Boost Sensor B Circuit High	U0162	Lost Communication With Navigation Display Module
P0243	Turbocharger Wastegate Solenoid A Malfunction	U0163	Lost Communication With Navigation Control Module
P0244	Turbocharger Wastegate Solenoid A Range/Performance	U0164	Lost Communication With HVAC Control Module
P0245	Turbocharger Wastegate Solenoid A Low	U0165	Lost Communication With HVAC Control Module
P0246	Turbocharger Wastegate Solenoid A High	U0166	Lost Communication With Auxiliary Heater Control Module
P0247	Turbocharger Wastegate Solenoid B Malfunction	U0167	Lost Communication With Vehicle Immobilizer Control Module
P0248	Turbocharger Wastegate Solenoid B Range/Performance	U0168	Lost Communication With Vehicle Security Control Module
P0249	Turbocharger Wastegate Solenoid B Low	U0169	Lost Communication With Sunroof Control Module
P0250	Turbocharger Wastegate Solenoid B High	U0170	Lost Communication With "Restraints System Sensor A"
P0251	Injection Pump Fuel Metering Control "A" Malfunction (Cam/Rotor/Injector)	U0171	Lost Communication With "Restraints System Sensor B"
P0252	Injection Pump Fuel Metering Control "A" Range/Performance (Cam/Rotor/Injector)	U0172	Lost Communication With "Restraints System Sensor C"
P0253	Injection Pump Fuel Metering Control "A" Low	U0173	Lost Communication With "Restraints System Sensor D"

	(Cam/Rotor/Injector)		
P0254	Injection Pump Fuel Metering Control "A" High (Cam/Rotor/Injector)	U0174	Lost Communication With "Restraints System Sensor E"
P0255	Injection Pump Fuel Metering Control "A" Intermittent (Cam/Rotor/Injector)	U0175	Lost Communication With "Restraints System Sensor F"
P0256	Injection Pump Fuel Metering Control "B" Malfunction (Cam/Rotor/Injector)	U0176	Lost Communication With "Restraints System Sensor G"
P0257	Injection Pump Fuel Metering Control "B" Range/Performance Injector)	U0177	Lost Communication With "Restraints System Sensor H"
P0258	Injection Pump Fuel Metering Control "B" Low (Cam/R	U0178	Lost Communication With "Restraints System Sensor I"
P0259	Injection Pump Fuel Metering Control "B" High (Cam/R	U0179	Lost Communication With "Restraints System Sensor J"
P0260	Injection Pump Fuel Metering Control "B" Intermittent Injector)	U0180	Lost Communication With Automatic Lighting Control Module
P0261	Cylinder I Injector Circuit Low	U0181	Lost Communication With Headlamp Leveling Control Module
P0262	Cylinder I Injector Circuit High	U0182	Lost Communication With Lighting Control Module
P0263	Cylinder I Contribution/Balance Fault	U0183	Lost Communication With Lighting Control Module
P0264	Cylinder 2 Injector Circuit Low	U0184	Lost Communication With Radio
P0265	Cylinder 2 Injector Circuit High	U0185	Lost Communication With Antenna Control Module
P0266	Cylinder 2 Contribution/Balance Fault	U0186	Lost Communication With Audio Amplifier
P0267	Cylinder 3 Injector Circuit Low	U0187	Lost Communication With Digital Disc Player/Changer Module "A"
P0268	Cylinder 3 Injector Circuit High	U0188	Lost Communication With Digital Disc Player/Changer Module "B"
P0269	Cylinder 3 Contribution/Balance Fault	U0189	Lost Communication With Digital Disc Player/Changer Module "C"
P0270	Cylinder 4 Injector Circuit Low	U0190	Lost Communication With Digital Disc Player/Changer Module "D"
P0271	Cylinder 4 Injector Circuit High	U0191	Lost Communication With Television
P0272	Cylinder 4 Contribution/Balance Fault	U0192	Lost Communication With Personal Computer
P0273	Cylinder 5 Injector Circuit Low	U0193	Lost Communication With "Digital Audio Control Module A"
P0274	Cylinder 5 Injector Circuit High	U0194	Lost Communication With "Digital Audio Control Module B"
P0275	Cylinder S Contribution/Balance Fault	U0195	Lost Communication With Subscription Entertainment Receiver Module
P0276	Cylinder 6 Injector Circuit Low	U0196	Lost Communication With Rear Seat Entertainment Control Module
P0277	Cylinder 6 Injector Circuit High	U0197	Lost Communication With Telephone Control Module
P0278	Cylinder 6 Contribution/Balance Fault	U0198	Lost Communication With Telematic Control Module
P0279	Cylinder 7 Injector Circuit Low	U0199	Lost Communication With "Door Control Module A"
P0280	Cylinder 7 Injector Circuit High	U0200	Lost Communication With "Door Control Module B"
P0281	Cylinder 7 Contribution/Balance Fault	U0201	Lost Communication With "Door Control Module C"
P0282	Cylinder 8 Injector Circuit Low	U0202	Lost Communication With "Door Control Module D"
P0283	Cylinder 8 Injector Circuit High	U0203	Lost Communication With "Door Control Module E"
P0284	Cylinder 8 Contribution/Balance Fault	U0204	Lost Communication With "Door Control Module F"
P0285	Cylinder 9 Injector Circuit Low	U0205	Lost Communication With "Door Control Module G"
P0286	Cylinder 9 Injector Circuit High	U0206	Lost Communication With Folding Top Control Module
P0287	Cylinder 9 Contribution/Balance Fault	U0207	Lost Communication With Movable Roof Control Module
P0288	Cylinder 10 Injector Circuit Low	U0208	Lost Communication With "Seat Control Module A"
P0289	Cylinder 10 Injector Circuit High	U0209	Lost Communication With "Seat Control Module B"
P0290	Cylinder 10 Contribution/Balance Fault	U0210	Lost Communication With "Seat Control Module C"
P0291	Cylinder 11 Injector Circuit Low	U0211	Lost Communication With "Seat Control Module D"
P0292	Cylinder 11 Injector Circuit High	U0212	Lost Communication With Steering Column Control Module
P0293	Cylinder 11 Contribution/Balance Fault	U0213	Lost Communication With Mirror Control Module
P0294	Cylinder 12 Injector Circuit Low	U0214	Lost Communication With Remote Function Actuation
P0295	Cylinder 12 Injector Circuit High	U0215	Lost Communication With "Door Switch A"
P0296	Cylinder 12 Contribution/Range Fault	U0216	Lost Communication With "Door Switch B"
		U0217	Lost Communication With "Door Switch C"
DTC Codes - P0300-P0399 – Ignition System or Misfire		U0218	Lost Communication With "Door Switch D"
DTC	Description	U0219	Lost Communication With "Door Switch E"
P0300	Random/Multiple Cylinder Misfire Detected	U0220	Lost Communication With "Door Switch F"
P0301	Cylinder 1 Misfire Detected	U0221	Lost Communication With "Door Switch G"
P0302	Cylinder 2 Misfire Detected	U0222	Lost Communication With "Door Window Motor A"
P0303	Cylinder 3 Misfire Detected	U0223	Lost Communication With "Door Window Motor B"
P0304	Cylinder 4 Misfire Detected	U0224	Lost Communication With "Door Window Motor C"
P0305	Cylinder 5 Misfire Detected	U0225	Lost Communication With "Door Window Motor D"
P0306	Cylinder 6 Misfire Detected	U0226	Lost Communication With "Door Window Motor E"
P0307	Cylinder 7 Misfire Detected	U0227	Lost Communication With "Door Window Motor F"

P0308	Cylinder 8 Misfire Detected	U0228	Lost Communication With "Door Window Motor G"
P0309	Cylinder 9 Misfire Detected	U0229	Lost Communication With Heated Steering Wheel Module
P0311	Cylinder 11 Misfire Detected	U0230	Lost Communication With Rear Gate Module
P0312	Cylinder 12 Misfire Detected	U0231	Lost Communication With Rain Sensing Module
P0320	Ignition/Distributor Engine Speed Input Circuit Malfunction	U0232	Lost Communication With Side Obstacle Detection Control Module
P0321	Ignition/Distributor Engine Speed Input Circuit Range/Performance	U0233	Lost Communication With Side Obstacle Detection Control Module
P0322	Ignition/Distributor Engine Speed Input Circuit No Signal	U0234	Lost Communication With Convenience Recall Module
P0323	Ignition/Distributor Engine Speed Input Circuit Intermittent	U0235	Lost Communication With Cruise Control Front Distance Range Sensor
P0325	Knock Sensor 1 Circuit Malfunction (Bank I or Single Sensor)	U0300	Internal Control Module Software Incompatibility
P0326	Knock Sensor 1 Circuit Range/Performance (Bank 1 or Single Sensor)	U0301	Software Incompatibility with ECM/PCM
P0327	Knock Sensor 1 Circuit Low Input (Bank I or Single Sensor)	U0302	Software Incompatibility with Transmission Control Module
P0328	Knock Sensor 1 Circuit High Input (Bank I or Single Sensor)	U0303	Software Incompatibility with Transfer Case Control Module
P0329	Knock Sensor 1 Circuit Intermittent (Bank 1 or Single Sensor)	U0304	Software Incompatibility with Gear Shift Control Module
P0330	Knock Sensor 2 Circuit Malfunction (Bank 2)	U0305	Software Incompatibility with Cruise Control Module
P0331	Knock Sensor 2 Circuit Range/Performance (Bank 2)	U0306	Software Incompatibility with Fuel Injector Control Module
P0332	Knock Sensor 2 Circuit Low Input (Bank 2)	U0307	Software Incompatibility with Glow Plug Control Module
P0333	Knock Sensor 2 Circuit High Input (Bank 2)	U0308	Software Incompatibility with Throttle Actuator Control Module
P0334	Knock Sensor 2 Circuit Intermittent (Bank 2)	U0309	Software Incompatibility with Alternative Fuel Control Module
P0335	Crankshaft Position Sensor A Circuit Malfunction	U0310	Software Incompatibility with Fuel Pump Control Module
P0336	Crankshaft Position Sensor A Circuit Range/Performance	U0311	Software Incompatibility with Drive Motor Control Module
P0337	Crankshaft Position Sensor A Circuit Low Input	U0312	Software Incompatibility with Battery Energy Control Module A
P0338	Crankshaft Position Sensor A Circuit High Input	U0313	Software Incompatibility with Battery Energy Control Module B
P0339	Crankshaft Position Sensor A Circuit Intermittent	U0314	Software Incompatibility with Four-Wheel Drive Clutch Control Module
P0340	Camshaft Position Sensor Circuit Malfunction	U0315	Software Incompatibility with Anti-Lock Brake System Control Module
P0341	Camshaft Position Sensor Circuit Range/Performance	U0316	Software Incompatibility with Vehicle Dynamics Control Module
P0342	Camshaft Position Sensor Circuit Low Input	U0317	Software Incompatibility with Park Brake Control Module
P0343	Camshaft Position Sensor Circuit High Input	U0318	Software Incompatibility with Brake System Control Module
P0344	Camshaft Position Sensor Circuit Intermittent	U0319	Software Incompatibility with Steering Effort Control Module
P0350	Ignition Coil Primary/Secondary Circuit Malfunction	U0320	Software Incompatibility with Power Steering Control Module
P0351	Ignition Coil A Primary/Secondary Circuit Malfunction	U0321	Software Incompatibility with Ride Level Control Module
P0352	Ignition Coil B Primary/Secondary Circuit Malfunction	U0322	Software Incompatibility with Body Control Module
P0353	Ignition Coil C Primary/Secondary Circuit Malfunction	U0323	Software Incompatibility with Instrument Panel Control Module
P0354	Ignition Coil D Primary/Secondary Circuit Malfunction	U0324	Software Incompatibility with HVAC Control Module
P0355	Ignition Coil E Primary/Secondary Circuit Malfunction	U0325	Software Incompatibility with Auxiliary Heater Control Module
P0356	Ignition Coil F Primary/Secondary Circuit Malfunction	U0326	Software Incompatibility with Vehicle Immobilizer Control Module
P0357	Ignition Coil G Primary/Secondary Circuit Malfunction	U0327	Software Incompatibility with Vehicle Security Control Module
P0358	Ignition Coil H Primary/Secondary Circuit Malfunction	U0328	Software Incompatibility with Steering Angle Sensor Module
P0359	Ignition Coil I Primary/Secondary Circuit Malfunction	U0329	Software Incompatibility with Steering Column Control Module
P0360	Ignition Coil J Primary/Secondary Circuit Malfunction	U0330	Software Incompatibility with Tire Pressure Monitor Module
P0361	Ignition Coil K Primary/Secondary Circuit Malfunction	U0331	Software Incompatibility with Body Control Module "A"
P0362	Ignition Coil L Primary/Secondary Circuit Malfunction	U0400	Invalid Data Received
P0370	Timing Reference High Resolution Signal A Malfunction	U0401	Invalid Data Received From ECM/PCM
P0371	Timing Reference High Resolution Signal A Too Many Pulses	U0402	Invalid Data Received From Transmission Control Module
P0372	Timing Reference High Resolution Signal A Too Few Pulses	U0403	Invalid Data Received From Transfer Case Control Module
P0373	Timing Reference High Resolution Signal A Intermittent/Erratic Pulses	U0404	Invalid Data Received From Gear Shift Control Module
P0374	Timing Reference High Resolution Signal A No Pulses	U0405	Invalid Data Received From Cruise Control Module
P0375	Timing Reference High Resolution Signal B Malfunction	U0406	Invalid Data Received From Fuel Injector Control Module
P0376	Timing Reference High Resolution Signal B Too Many Pulses	U0407	Invalid Data Received From Glow Plug Control Module
P0377	Timing Reference High Resolution Signal B Too Few Pulses	U0408	Invalid Data Received From Throttle Actuator Control Module
P0378	Timing Reference High Resolution Signal B Intermittent/Erratic Pulses	U0409	Invalid Data Received From Alternative Fuel Control Module
P0379	Timing Reference High Resolution Signal B No Pulses	U0410	Invalid Data Received From Fuel Pump Control Module
P0380	Glow Plug/Heater Circuit "A" Malfunction	U0411	Invalid Data Received From Drive Motor Control Module
P0381	Glow Plug/Heater Indicator Circuit Malfunction	U0412	Invalid Data Received From Battery Energy Control Module A
P0382	Exhaust Gas Recirculation Flow Malfunction	U0413	Invalid Data Received From Battery Energy Control Module B
P0385	Crankshaft Position Sensor B Circuit Malfunction	U0414	Invalid Data Received From Four-Wheel Drive Clutch Control Module

P0386	Crankshaft Position Sensor B Circuit Range/Performance	U0415	Invalid Data Received From Anti-Lock Brake System Control Module
P0387	Crankshaft Position Sensor B Circuit Low Input	U0416	Invalid Data Received From Vehicle Dynamics Control Module
P0388	Crankshaft Position Sensor B Circuit High Input	U0417	Invalid Data Received From Park Brake Control Module
P0389	Crankshaft Position Sensor B Circuit Intermittent	U0418	Invalid Data Received From Brake System Control Module
		U0419	Invalid Data Received From Steering Effort Control Module
DTC Codes - P0400-P0499 – Auxiliary Emissions Controls			U0420
DTC	Description	U0421	Invalid Data Received From Ride Level Control Module
P0400	Exhaust Gas Recirculation Flow Malfunction	U0422	Invalid Data Received From Body Control Module
P0401	Exhaust Gas Recirculation Flow Insufficient Detected	U0423	Invalid Data Received From Instrument Panel Control Module
P0402	Exhaust Gas Recirculation Flow Excessive Detected	U0424	Invalid Data Received From HVAC Control Module
P0403	Exhaust Gas Recirculation Circuit Malfunction	U0425	Invalid Data Received From Auxiliary Heater Control Module
P0404	Exhaust Gas Recirculation Circuit Range/Performance	U0426	Invalid Data Received From Vehicle Immobilizer Control Module
P0405	Exhaust Gas Recirculation Sensor A Circuit Low	U0427	Invalid Data Received From Vehicle Security Control Module
P0406	Exhaust Gas Recirculation Sensor A Circuit High	U0428	Invalid Data Received From Steering Angle Sensor Module
P0407	Exhaust Gas Recirculation Sensor B Circuit Low	U0429	Invalid Data Received From Steering Column Control Module
P0408	Exhaust Gas Recirculation Sensor B Circuit High	U0430	Invalid Data Received From Tire Pressure Monitor Module
P0410	Secondary Air Injection System Malfunction	U0431	Invalid Data Received From Body Control Module "A"
P0411	Secondary Air Injection System Incorrect Flow Detected		
P0412	Secondary Air Injection System Switching Valve A Circuit Malfunction		
P0413	Secondary Air Injection System Switching Valve A Circuit Open		
P0414	Secondary Air Injection System Switching Valve A Circuit Shorted		
P0415	Secondary Air Injection System Switching Valve B Circuit Malfunction		
P0416	Secondary Air Injection System Switching Valve B Circuit Open		
P0417	Secondary Air Injection System Switching Valve B Circuit Shorted		
P0418	Secondary Air Injection System Relay ‘A" Circuit Malfunction		
P0419	Secondary Air Injection System Relay "B’ Circuit Malfunction		
P0420	Catalyst System Efficiency Below Threshold (Bank 1)		
P0421	Warm Up Catalyst Efficiency Below Threshold (Bank 1)		
P0422	Main Catalyst Efficiency Below Threshold (Bank 1)		
P0423	Heated Catalyst Efficiency Below Threshold (Bank 1)		
P0424	Heated Catalyst Temperature Below Threshold (Bank 1)		
P0430	Catalyst System Efficiency Below Threshold (Bank 2)		
P0431	Warm Up Catalyst Efficiency Below Threshold (Bank 2)		
P0432	Main Catalyst Efficiency Below Threshold (Bank 2)		
P0433	Heated Catalyst Efficiency Below Threshold (Bank 2)		
P0434	Heated Catalyst Temperature Below Threshold (Bank 2)		
P0440	Evaporative Emission Control System Malfunction		
P0441	Evaporative Emission Control System Incorrect Purge Flow		
P0442	Evaporative Emission Control System Leak Detected (small leak)		
P0443	Evaporative Emission Control System Purge Control Valve Circuit		
P0444	Evaporative Emission Control System Purge Control Valve Circuit		
P0445	Evaporative Emission Control System Purge Control Valve Circuit Shorted		
P0446	Evaporative Emission Control System Vent Control Circuit Malfunction		
P0447	Evaporative Emission Control System Vent Control Circuit Open		
P0448	Evaporative Emission Control System Vent Control Circuit Shorted		
P0449	Evaporative Emission Control System Vent Valve/Solenoid Circuit Malfunction		
P0450	Evaporative Emission Control System Pressure Sensor Malfunction		
P0451	Evaporative Emission Control System Pressure Sensor Range/Performance		
P0452	Evaporative Emission Control System Pressure Sensor Low Input		
P0453	Evaporative Emission Control System Pressure Sensor High Input		
P0454	Evaporative Emission Control System Pressure Sensor Intermittent		
P0455	Evaporative Emission Control System Leak Detected (gross leak)		
P0460	Fuel Level Sensor Circuit Malfunction		
P0461	Fuel Level Sensor Circuit Range/Performance		
P0462	Fuel Level Sensor Circuit Low Input		
P0463	Fuel Level Sensor Circuit High Input		
P0464	Fuel Level Sensor Circuit Intermittent		
P0465	Purge Flow Sensor Circuit Malfunction		
P0466	Purge Flow Sensor Circuit Range/Performance		
P0467	Purge Flow Sensor Circuit Low Input		
P0468	Purge Flow Sensor Circuit High Input		
P0469	Purge Flow Sensor Circuit Intermittent		
P0470	Exhaust Pressure Sensor Malfunction		

P0471	Exhaust Pressure Sensor Range/Performance	
P0472	Exhaust Pressure Sensor Low	
P0473	Exhaust Pressure Sensor High	
P0474	Exhaust Pressure Sensor Intermittent	
P0475	Exhaust Pressure Control Valve Malfunction	
P0476	Exhaust Pressure Control Valve Range/Performance	
P0477	Exhaust Pressure Control Valve Low	
P0478	Exhaust Pressure Control Valve High	
P0479	Exhaust Pressure Control Valve Intermittent	
P0480	Cooling Fan I Control Circuit Malfunction	
P0481	Cooling Fan 2 Control Circuit Malfunction	
P0482	Cooling Fan 3 Control Circuit Malfunction	
P0483	Cooling Fan Rationality Check Malfunction	
P0484	Cooling Fan Circuit Over Current	
P0485	Cooling Fan Power/Ground Circuit Malfunction	
DTC Codes - P0500-P0599 – Vehicle Speed Controls and Idle Control System		
DTC	Description	
P0500	Vehicle Speed Sensor Malfunction	
P0501	Vehicle Speed Sensor Range/Performance	
P0502	Vehicle Speed Sensor Low Input	
P0503	Vehicle Speed Sensor Intermittent/Erratic/High	
P0505	Idle Control System Malfunction	
P0506	Idle Control System RPM Lower Than Expected	
P0507	Idle Control System RPM Higher Than Expected	
P0510	Closed Throttle Position Switch Malfunction	
P0520	Engine Oil Pressure Sensor/Switch Circuit Malfunction	
P0521	Engine Oil Pressure Sensor/Switch Circuit Range/Performance	
P0522	Engine Oil Pressure Sensor/Switch Circuit Low Voltage	
P0523	Engine Oil Pressure Sensor/Switch Circuit High Voltage	
P0530	A/C Refrigerant Pressure Sensor Circuit Malfunction	
P0531	A/C Refrigerant Pressure Sensor Circuit Range/Performance	
P0532	A/C Refrigerant Pressure Sensor Circuit Low Input	
P0533	A/C Refrigerant Pressure Sensor Circuit High Input	
P0534	Air Conditioner Refrigerant Charge Loss	
P0550	Power Steering Pressure Sensor Circuit Malfunction	
P0551	Power Steering Pressure Sensor Circuit Range/Performance	
P0552	Power Steering Pressure Sensor Circuit Low Input	
P0553	Power Steering Pressure Sensor Circuit High Input	
P0554	Power Steering Pressure Sensor Circuit Intermittent	
P0560	System Voltage Malfunction	
P0561	System Voltage Unstable	
P0562	System Voltage Low	
P0563	System Voltage High	
P0565	Cruise Control On Signal Malfunction	
P0566	Cruise Control Off Signal Malfunction	
P0567	Cruise Control Resume Signal Malfunction	
P0568	Cruise Control Set Signal Malfunction	
P0569	Cruise Control Coast Signal Malfunction	
P0570	Cruise Control Accel Signal Malfunction	
P0571	Cruise Control/Brake Switch A Circuit Malfunction	
P0572	Cruise Control/Brake Switch A Circuit Low	
P0573	Cruise Control/Brake Switch A Circuit High	
P0574	Cruise Control Related Malfunction	
P0575	Cruise Control Related Malfunction	
P0576	Cruise Control Related Malfunction	
P0576	Cruise Control Related Malfunction	
P0578	Cruise Control Related Malfunction	
P0579	Cruise Control Related Malfunction	
P0580	Cruise Control Related Malfunction	
DTC Codes - P0600-P0699 – Computer Output Circuit		
DTC	Description	
P0600	Serial Communication Link Malfunction	
P0601	Internal Control Module Memory Check Sum Error	

P0602	Control Module Programming Error	
P0603	Internal Control Module Keep Alive Memory (KAM) Error	
P0604	Internal Control Module Random Access Memory (RAM) Error	
P0605	Internal Control Module Read Only Memory (ROM) Error	
P0606	PCM Processor Fault	
P0608	Control Module VSS Output "A' Malfunction	
P0609	Control Module VSS Output "B" Malfunction	
P0620	Generator Control Circuit Malfunction	
P0621	Generator Lamp "L" Control Circuit Malfunction	
P0622	Generator Field "F" Control Circuit Malfunction	
P0650	Malfunction Indicator Lamp (MIL) Control Circuit Malfunction	
P0654	Engine RPM Output Circuit Malfunction	
P0655	Engine Hot Lamp Output Control Circuit Malfunction	
P0656	Fuel Level Output Circuit Malfunction	
DTC Codes - P0700-P0899 – Transmission		
DTC	Description	
P0700	Transmission Control System Malfunction	
P0701	Transmission Control System Range/Performance	
P0702	Transmission Control System Electrical	
P0703	Torque Converter/Brake Switch B Circuit Malfunction	
P0704	Clutch Switch Input Circuit Malfunction	
P0705	Transmission Range Sensor Circuit malfunction (PRNDL Input)	
P0706	Transmission Range Sensor Circuit Range/Performance	
P0707	Transmission Range Sensor Circuit Low Input	
P0708	Transmission Range Sensor Circuit High Input	
P0709	Transmission Range Sensor Circuit Intermittent	
P0710	Transmission Fluid Temperature Sensor Circuit Malfunction	
P0711	Transmission Fluid Temperature Sensor Circuit Range/Performance	
P0712	Transmission Fluid Temperature Sensor Circuit Low Input	
P0713	Transmission Fluid Temperature Sensor Circuit High Input	
P0714	Transmission Fluid Temperature Sensor Circuit Intermittent	
P0715	Input/Turbine Speed Sensor Circuit Malfunction	
P0716	Input/Turbine Speed Sensor Circuit Range/Performance	
P0717	Input/Turbine Speed Sensor Circuit No Signal	
P0718	Input/Turbine Speed Sensor Circuit Intermittent	
P0719	Torque Converter/Brake Switch B Circuit Low	
P0720	Output Speed Sensor Circuit Malfunction	
P0721	Output Speed Sensor Range/Performance	
P0722	Output Speed Sensor No Signal	
P0723	Output Speed Sensor Intermittent	
P0724	Torque Converter/Brake Switch B Circuit High	
P0725	Engine Speed input Circuit Malfunction	
P0726	Engine Speed Input Circuit Range/Performance	
P0727	Engine Speed Input Circuit No Signal	
P0728	Engine Speed Input Circuit Intermittent	
P0730	Incorrect Gear Ratio	
P0731	Gear I Incorrect ratio	
P0732	Gear 2 Incorrect ratio	
P0733	Gear 3 Incorrect ratio	
P0734	Gear 4 Incorrect ratio	
P0735	Gear 5 Incorrect ratio	
P0736	Reverse incorrect gear ratio	
P0740	Torque Converter Clutch Circuit Malfunction	
P0741	Torque Converter Clutch Circuit Performance or Stuck Off	
P0742	Torque Converter Clutch Circuit Stock On	
P0743	Torque Converter Clutch Circuit Electrical	
P0744	Torque Converter Clutch Circuit Intermittent	
P0745	Pressure Control Solenoid Malfunction	
P0746	Pressure Control Solenoid Performance or Stuck Off	
P0747	Pressure Control Solenoid Stuck On	
P0748	Pressure Control Solenoid Electrical	
P0749	Pressure Control Solenoid Intermittent	
P0750	Shift Solenoid A Malfunction	
P0751	Shift Solenoid A Performance or Stuck Off	

P0752	Shift Solenoid A Stuck On	
P0753	Shift Solenoid A Electrical	
P0754	Shift Solenoid A Intermittent	
P0755	Shift Solenoid B Malfunction	
P0756	Shift Solenoid B Performance or Stock Off	
P0757	Shift Solenoid B Stuck On	
P0758	Shift Solenoid B Electrical	
P0759	Shift Solenoid B Intermittent	
P0760	Shift Solenoid C Malfunction	
P076	I Shift Solenoid C Performance or Stuck Off	
P0762	Shift Solenoid C Stuck On	
P0763	Shift Solenoid C Electrical	
P0764	Shift Solenoid C Intermittent	
P0765	Shift Solenoid D Malfunction	
P0766	Shift Solenoid D Performance or Stuck Off	
P0767	Shift Solenoid D Stuck On	
P0768	Shift Solenoid D Electrical	
P0769	Shift Solenoid D Intermittent	
P0770	Shift Solenoid E Malfunction	
P0771	Shift Solenoid E Performance or Stuck Off	
P0772	Shift Solenoid E Stuck On	
P0773	Shift Solenoid E Electrical	
P0774	Shift Solenoid E Intermittent	
P0780	Shift Malfunction	
P0781	1-2 Shift Malfunction	
P0782	2-3 Shift Malfunction	
P0783	3-4 Shift Malfunction	
P0784	4-5 Shift Malfunction	
P0785	Shift/Timing Solenoid Malfunction	
P0786	Shift/Timing Solenoid Range/Performance	
P0787	Shift/Timing Solenoid Low	
P0788	Shift/Timing Solenoid High	
P0789	Shift/Timing Solenoid Intermittent	
P0790	Normal/Performance Switch Circuit Malfunction	
P0801	Reverse Inhibit Control Circuit Malfunction	
P0803	1-4 Upshift (Skip Shift) Solenoid Control Circuit Malfunction	
P0804	1-4 Upshift (Skip Shift) Lamp Control Circuit Malfunction	
P0805	Clutch Position Sensor Circuit	
P0806	Clutch Position Sensor Circuit Range/Performance	
P0807	Clutch Position Sensor Circuit Low	
P0808	Clutch Position Sensor Circuit High	
P0809	Clutch Position Sensor Circuit Intermittent	
P0810	Clutch Position Control Error	
P0811	Excessive Clutch Slippage	
P0812	Reverse Input Circuit	
P0813	Reverse Output Circuit	
P0814	Transmission Range Display Circuit	
P0815	Upshift Switch Circuit	
P0816	Downshift Switch Circuit	
P0817	Starter Disable Circuit	
P0818	Driveline Disconnect Switch Input Circuit	
P0819	Up and Down Shift Switch to Transmission Range Correlation	
P0820	Gear Lever X-Y Position Sensor Circuit	
P0821	Gear Lever X Position Circuit	
P0822	Gear Lever Y Position Circuit	
P0823	Gear Lever X Position Circuit Intermittent	
P0824	Gear Lever Y Position Circuit Intermittent	
P0825	Gear Lever Push-Pull Switch (Shift Anticipate)	
P0826	Up and Down Shift Switch Circuit	
P0827	Up and Down Shift Switch Circuit Low	
P0828	Up and Down Shift Switch Circuit High	
P0829	5-6 Shift	
P0830	Clutch Pedal Switch "A" Circuit	
P0831	Clutch Pedal Switch "A" Circuit Low	
P0832	Clutch Pedal Switch "A" Circuit High	

P0833	Clutch Pedal Switch "B" Circuit	
P0834	Clutch Pedal Switch "B" Circuit Low	
P0835	Clutch Pedal Switch "B" Circuit High	
P0836	Four Wheel Drive (4WD) Switch Circuit	
P0837	Four Wheel Drive (4WD) Switch Circuit Range/Performance	
P0838	Four Wheel Drive (4WD) Switch Circuit Low	
P0839	Four Wheel Drive (4WD) Switch Circuit High	
P0840	Transmission Fluid Pressure Sensor/Switch "A" Circuit	
P0841	Transmission Fluid Pressure Sensor/Switch "A" Circuit Range/Performance	
P0842	Transmission Fluid Pressure Sensor/Switch "A" Circuit Low	
P0843	Transmission Fluid Pressure Sensor/Switch "A" Circuit High	
P0844	Transmission Fluid Pressure Sensor/Switch "A" Circuit Intermittent	
P0845	Transmission Fluid Pressure Sensor/Switch "B" Circuit	
P0846	Transmission Fluid Pressure Sensor/Switch "B" Circuit Range/Performance	
P0847	Transmission Fluid Pressure Sensor/Switch "B" Circuit Low	
P0848	Transmission Fluid Pressure Sensor/Switch "B" Circuit High	
P0849	Transmission Fluid Pressure Sensor/Switch "B" Circuit Intermittent	
P0850	Park/Neutral Switch Input Circuit	
P0851	Park/Neutral Switch Input Circuit Low	
P0852	Park/Neutral Switch Input Circuit High	
P0853	Drive Switch Input Circuit	
P0854	Drive Switch Input Circuit Low	
P0855	Drive Switch Input Circuit High	
P0856	Traction Control Input Signal	
P0857	Traction Control Input Signal Range/Performance	
P0858	Traction Control Input Signal Low	
P0859	Traction Control Input Signal High	
P0860	Gear Shift Module Communication Circuit	
P0861	Gear Shift Module Communication Circuit Low	
P0862	Gear Shift Module Communication Circuit High	
P0863	TCM Communication Circuit	
P0864	TCM Communication Circuit Range/Performance	
P0865	TCM Communication Circuit Low	
P0866	TCM Communication Circuit High	
P0867	Transmission Fluid Pressure	
P0868	Transmission Fluid Pressure Low	
P0869	Transmission Fluid Pressure High	
P0870	Transmission Fluid Pressure Sensor/Switch "C" Circuit	
P0871	Transmission Fluid Pressure Sensor/Switch "C" Circuit Range/Performance	
P0872	Transmission Fluid Pressure Sensor/Switch "C" Circuit Low	
P0873	Transmission Fluid Pressure Sensor/Switch "C" Circuit High	
P0874	Transmission Fluid Pressure Sensor/Switch "C" Circuit Intermittent	
P0875	Transmission Fluid Pressure Sensor/Switch "D" Circuit	
P0876	Transmission Fluid Pressure Sensor/Switch "D" Circuit Range/Performance	
P0877	Transmission Fluid Pressure Sensor/Switch "D" Circuit Low	
P0878	Transmission Fluid Pressure Sensor/Switch "D" Circuit High	
P0879	Transmission Fluid Pressure Sensor/Switch "D" Circuit Intermittent	
P0880	TCM Power Input Signal	
P0881	TCM Power Input Signal Range/Performance	
P0882	TCM Power Input Signal Low	
P0883	TCM Power Input Signal High	
P0884	TCM Power Input Signal Intermittent	
P0885	TCM Power Relay Control Circuit/Open	
P0886	TCM Power Relay Control Circuit Low	
P0887	TCM Power Relay Control Circuit High	
P0888	TCM Power Relay Sense Circuit	
P0889	TCM Power Relay Sense Circuit Range/Performance	
P0890	TCM Power Relay Sense Circuit Low	
P0891	TCM Power Relay Sense Circuit High	
P0892	TCM Power Relay Sense Circuit Intermittent	
P0893	Multiple Gears Engaged	
P0894	Transmission Component Slipping	
P0895	Shift Time Too Short	
P0896	Shift Time Too Long	
P0897	Transmission Fluid Deteriorated	

P0898	Transmission Control System MIL Request Circuit Low	
P0899	Transmission Control System MIL Request Circuit High	

Table C - 1 Table of generic Diagnostics Trouble Codes